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AGRICULTURAL ENGINEERING

The Journal of the American Society of Agricultural Engineers

DECEMBER 1929

Engineering's Contribution to Agricultural Prosperity - - - - *W. G. Kaiser*

Opportunities in Agricultural Engineering Research - - - - *R. W. Trullinger*

The Present Trend in Rural Electrification - - - - - - - - - - - *W. C. Krueger*

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VOL. 10 NO. 12

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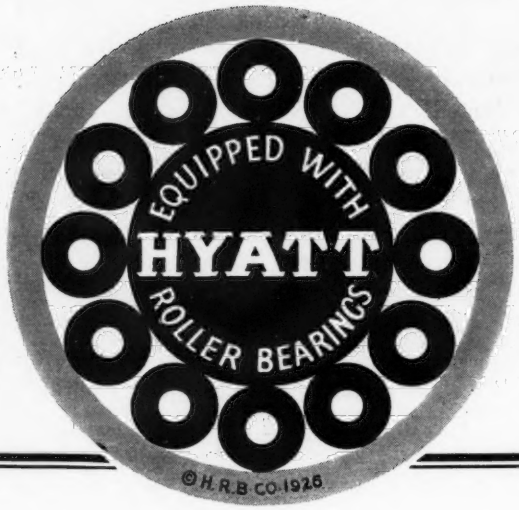

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AGRICULTURAL ENGINEERING

Vol. 10 DECEMBER, 1929 No. 12

Engineering's Contribution to Agricultural Prosperity[1]

By W. G. Kaiser[2]

President, American Society of Agricultural Engineers

IN OUR proposed platform submitted to the membership in June, the American Society of Agricultural Engineers pledges "its best efforts to help agricultural people achieve, through engineering means, a more stable prosperity and higher standards of living." At no previous time has the agricultural engineer had such an excellent opportunity to carry out the spirit and the letter of this pledge and render a lasting service to agriculture.

W. G. Kaiser

We are confronted with a serious agricultural problem, the solution of which depends upon consideration of many factors. It is my belief that the agricultural engineer is destined to be an increasingly important factor in bringing a greater measure of prosperity to the farmers of this country. You are all acquainted with the fact that a special session of Congress was called by President Hoover and a farm bill was passed authorizing the establishment of the Federal Farm Board. This board has been assigned the task of evolving ways and means of bringing relief to the distressed agricultural industry. You are all familiar with the provisions of the bill and the excellent qualifications of the members of the board. The immediate objective of the board is summed up in the following statement by the Hon. Arthur M. Hyde, Secretary of Agriculture:

"Generally speaking, the board is striving to bring about a reorganization of agriculture through farm cooperative associations in such a fashion as will make agriculture a cohesive industry and give the farmer, through his own marketing association, control of his products from the field to the final market."

Among economists it is generally agreed that the establishment of orderly methods for marketing farm products affords perhaps the most direct route to immediate benefits for our agricultural people. There are not many, however, who are so optimistic as to believe that orderly marketing, however perfect, will in itself provide the ultimate solution of the problem. Other factors equally important must also undergo readjustment. Nor are the activities of the Federal Farm Board limited to "the promotion of effective merchandising of agricultural commodities." It has been given much broader powers in its assignment "to place agriculture on a basis of economic equality with other industries." Any measure which stops by merely increasing the prices the farmer gets for his products is only a partial solution.

Increased prices are always followed by increased production and increased production usually leads to overproduction, a glutted market and falling prices. Then follows a period of readjustments with decreased production. When supply and demand are again more nearly balanced, there is once more an improvement in prices. The farm bill directs the board to eliminate the disastrous dips in the price curve which are caused by overproduction. This is covered in Item 4, Section 4, of the bill which reads: "To investigate conditions of overproduction of agricultural commodities and advise as to the prevention of such overproduction."

As I interpret this the board is directed to take appropriate action to increase prices of farm commodities, yet, at the same time, it is supposed to hold overproduction in check. It is expected to do this despite the fact that one of the basic causes of overproduction is high prices.

There is severe competition in agriculture. Individual producers are competing against each other and the producers in other countries are in competition with our own farmers. We are selling on a world market and competition is largely on a price basis. While we are devising means to dispose of our surplus at a profit, the nations of the rest of the world are stimulating production at home and thereby reducing the amount of goods that must be imported. As a result, some countries have a surplus problem of their own. Our only chance to sell on the foreign market is to offer our commodities at a lower price than they can possibly be produced in the countries whose markets we seek. The probem then resolves itself into this: Which country can most economically produce and market its surplus commodities?

Many of our leading farmers do not anticipate permanent relief in the form of higher prices. Rather they are taking steps to cut production costs so that current prices will allow them a profit. They are preparing not only to meet the world wide competition but to win out.

Raising prices by legislative action is pretty certain to be short lived as a relief measure. We must face the fact that the majority of the people now live in cities and that their numbers are growing constantly larger. As a result, they hold the balance of power in political affairs. Should prices of farm products be artificially raised to a level which the city folks may regard as unreasonably high, there will follow a clamor for the dissolution of cooperatives, the revision of tariff schedules, or the initiation of measures which will tend to lower prices. There is a limit to which the price structure can be increased artificially. If that limit does not permit a fair profit, then the only alternative is to scale down the cost of production.

It is here that the agricultural engineer steps into the

[1]An address before a meeting of the North Atlantic Section of the American Society of Agricultural Engineers,, at Amherst, Mass., October, 1929.

[2]Agricultural engineer, Portland Cement Association. Mem. A.S.A.E.

picture. Frankly, I believe that the agricultural engineer will be the key man in the final solution of the problem of making agriculture an economic equal of other industries.

A review of the history of agricultural progress during the past century shows that the application of engineering has played an exceptionally important part in this development.

In 1800 approximately 97 per cent of the people in this country lived on farms. By hard work they were able to produce sufficient for their own consumption and for the small minority that lived in the cities. Under favorable conditions there was a small surplus for export. Methods employed in farming were essentially the same as those used in biblical days. Of interest in this connection is this statement by the Hon. William M. Jardine, former secretary of the U. S. Department of Agriculture: "Could the farmer of the Pharoahs' time have been suddenly reincarnated and set down in our grandfather's wheat field, he could have picked up the grain cradle and gone to work with a familiar tool at a perfectly familiar job."

Imagine the amazement of the ancient Egyptian if he were to be set down in a present day wheat field with the combined harvester and thresher in full operation.

In 1850 about 90 per cent of the population still resided on farms. The tools in use were largely "the implements of hand production." But, following the Civil War, greatly increased acreage was brought under cultivation in the western states and farm machinery was extensively introduced. Thirty years ago the movement of our rural folk to urban centers was well under way; machinery was taking the place of manual labor. Farm people then made up around 48 per cent of the total population.

By 1925 only 25 per cent of the total population was directly engaged in farming. Today less than one-fourth of the people produce food in ample quantities to feed all of the people of the nation with a large surplus to be sold on the world market. The disposal of this surplus is one of the farmer's problems. Mechanization of agriculture has made the American farmer the most efficient farmer in the world. That there is a direct relation between power used and the value of crops produced is strikingly shown in figures published in Bulletin No. 1348 of the U. S. Department of Agriculture.

Country or state	Primary power per agricultural worker	Value of crops produced annually
Italy	0.19	$ 45.00
France	0.37	90.00
Germany	0.55	119.00
United Kingdom	0.88	126.00
Alabama	0.81	112.00
Indiana	2.46	365.00
Iowa	3.86	595.00
Nebraska	4.71	910.00

We are proud of the fact that the American farmer is the most efficient farmer in the world. And this is an agricultural-engineering achievement of the highest order. This fact, however, should not be allowed to encourage the feeling that the job is done. It is only started. Farm surveys show that there is a wide difference in the cost of producing farm commodities. In an address, entitled 'Significant Changes in Agriculture," presented at the annual meeting at St. Paul (1927) of the American Society of Agricultural Engineers, Dean W. C. Coffey, of the University of Minnesota, made this statement:

"Records from statistical farms cooperating with the University of Minnesota show that the cost of producing butter fat on 25 farms located in the same community varied from 29 to 71 cents per pound, and the returns from cows ranged from a loss of $36.00 to a profit of $67.00 per cow for a year's period.

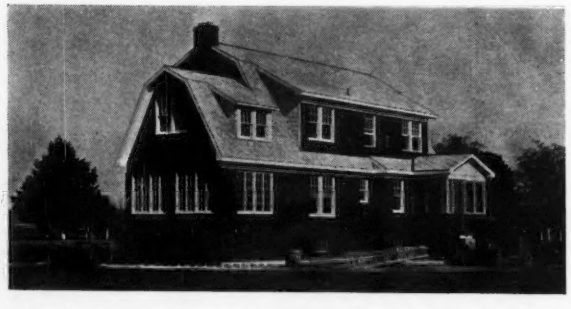
"In the case of poultry," Dean Coffey continued, "the feed cost as reported by the statistical farms last year ranged from $1.00 to $2.55 per hen, and the returns from the poultry ranged from a loss of 30 cents per hen to a profit of $1.50 above all costs."

The examples cited by Dean Coffey represent general conditions throughout the country. The report (1927 A.S.A.E. Transactions) of the A.S.A.E. Committee on Agricultural Production gives figures showing the wide differences which exist in the cost of producing cotton, oats, hay, rice and corn in different parts of the country. In these studies labor and 'power costs are four or five times higher in some instances than in others. Such wide differences in the cost of production can only imply efficiency on the one hand and extravagance or waste on the other. The dairyman producing butter at 71 cents a pound cannot compete in the same market with the man whose production costs are 29 cents a pound.

For some time a number of members of our Society have felt that the solution of the farm problem is closely related to the elimination of waste in agriculture. In other words, farm prosperity is the twin companion of farm efficiency. In September 1926 a special committee of this Society submitted to the American Engineering Council an outline for a study, entitled "Waste in Agriculture." In this outline it is pointed out that the cost of agricultural production consists of 40 to 80 per cent of power and labor. These are costs over which the farm operator has direct control. In industry labor costs are reduced by the substitution of labor-saving equipment. This can and is being done in agriculture. With the highest priced labor in the world, the efficient use of power and machinery makes it possible for us to produce rice and sell it to Japan in competition with rice produced with cheap Asiatic labor. What has been done with rice can be done with other farm commodities.

Time will not permit me to mention the innumerable ways in which the application of engineering increases efficiency and eliminates waste in agriculture. In the design and location of farm buildings, arrangement with thought to convenience saves labor and effects a reduction in the cost of production. Adequate housing of farm stock also promotes increased farm efficiency in the form of greater returns of animal products. The use of electricity about the house and the farmstead contributes not only to greater enjoyment of living for every member of the family but in numerous ways promotes greater efficiency by the substitution of electrical for manual power.

There are countless other ways in which the agricultural engineer will fit into the new pattern of agriculture. There never was a more opportune time for the agricultural engineer to serve our allied industries.



A rear view of one of the typical completely modern, brick veneer houses designed and analyzed by the agricultural engineering department of the University of Arkansas

Agricultural Engineering Research Opportunities in the North Atlantic States[1]

By R. W. Trullinger[2]

THE agriculture of the North Atlantic states is quite diverse. The region produces practically every crop grown in the northern United States, including small grains, corn, hay, tobacco, potatoes, truck crops and large and small fruits. Dairying and poultry production are also quite general throughout the section and appear to be the stable and more or less basic industries. While some fairly large farms may be found, the majority of the farms of the section are medium or relatively small in size. In certain limited areas the agriculture is devoted to one or more specialties but the systems of farming usually followed are diversified rather highly.

A first-hand perspective of the important agricultural problems of the section, as indicated by the research in progress at the agricultural experiment stations, has revealed numerous instances in which engineering could participate to advantage. Attention may be drawn to the general character of a few outstanding lines.

DAIRYING

Dairying constitutes an important division of the agriculture of at least twelve of the thirteen states included in the section. On an average or a small scale it offers the same problems of animal nutrition, housing, feeding and breeding for production, and of handling, processing and marketing of the products that are encountered in large scale dairying. Efficiency in the operations involved appears to be even more important.

Housing, with particular reference to maintaining the health, comfort and productiveness of the stock, and to saving time and labor in the necessary dairying operations, is perhaps the most immediate and pressing problem in dairying which should interest the engineers of the section. Several experiment stations of the section—particularly the Pennsylvania and New Hampshire stations—have been devoting considerable of their resources to studies of the respiration and metabolism of farm animals, establishing, among other things, the conditions of temperature, humidity, air movement, etc., essential in the proper housing of dairy stock. The engineers of the section should get closely into touch with this work, and on its results base investigations to develop new structures or to modify old structures to provide the required conditions. The durability, accessibility, and convenience of dairy barns also should be studied with the idea of minimizing the time and labor required for feeding, milking, stall cleaning, and other chores. Such studies supplemented by a consideration of the economics of the industry should aid extensively in determining the nature and extent of possible improvements. They demand a precise manipulation of the properties of structural materials and of the physics and dynamics of air movement, and call for close cooperation with dairy and agricultural economics specialists. The work on the development of natural draft ventilation systems, in progress at the New York Cornell Experiment Station, appears to be a proper beginning in this phase of investigation.

The proper handling and treatment of dairy products on a medium or small scale offers another important problem for engineers in the North Atlantic states. The bacteria of milk and their reaction to refrigeration and other treatments are under investigation at several experiment stations in the section, in endeavors to provide a high grade product with a minimum of treatment. The possibilities of precooling, ultra-violet ray treatment, flash pasteurization with electricity, and other processes offer numerous opportunities for engineers to join hands with dairy chemists and bacteriologists in working out economical and efficient processes for treating milk. Cheap and efficient methods and equipment developed elsewhere for the sterilization of dairy utensils may be modified by engineering studies, so that they can be adapted to the type of dairying practiced in the section. Here also the work calls for close cooperation with the dairy specialists and economists, and for technical knowledge and ability.

Dairy manufacturing may be a little apart from this discussion, yet several of the experiment stations of this section are studying phases of interest to engineers. For example, the manufacture of ice cream seems to present

[1]A paper prepared for presentation before a meeting of the North Atlantic Section of the American Society of Agricultural Engineers at Amherst, Mass., October 1929.

[2]Assistant in experiment station administration (senior agricultural engineer), Office of Experiment Stations, U. S. Department of Agriculture. Mem. A.S.A.E.

On account of the diversified, medium-scale farming in the North Atlantic states the development of small unit general-purpose tractors and machines for this area might be profitable. The harvesting operation especially seems susceptible of modification through the development of multiple-purpose labor saving machinery

many unsolved mechanical problems. The finding by the Maryland station that, by the use of blades which maintain their sharpness and to which the cream mixture does not adhere, ice cream considerably improved in quality can be produced with a great saving in time and power, offers a most interesting problem in engineering physics. The solution of the problem may lie in the establishment and practical control of the physical principles governing the frictional and adhesion relations between blade materials and cream mixtures.

These few typical cases suggest that the agricultural engineers of the section should become acquainted with the dairy and animal nutrition departments of their experiment stations and identify these points of profitable contact. It seems important, however, that they also keep closely in touch with the economic aspects of the situation as influenced by the limiting conditions of a diversified agriculture on a relatively medium or small scale, of which the dairying is likely to be a stable basic factor.

POULTRY PRODUCTION

The poultry industry of the North Atlantic states, like dairying, appears to be largely a basic feature of diversified farming and as such is widely distributed throughout the agriculture of practically every state in the region. While some of it is on a relatively large and rather specialized scale, the greater proportion of the poultry enterprises of the section are medium or small scale units. However, the problems of housing, breeding for production and disease resistance, disease control and nutrition do not differ essentially from those encountered in large scale poultry production.

The housing of poultry, especially in localities where the more severe climatic conditions prevail, offers an engineering problem of immediate importance. The principles governing the air and temperature requirements of producing poultry, established by the Iowa station under controlled conditions, appear to be applicable anywhere. The engineers could well undertake the proper adaptation of these principles to local climatic conditions and materials of construction in the development of proper housing conditions for poultry. Close cooperation with the poultry specialists seems especially desirable in this work not only to adhere to already established requirements for poultry housing but in order to eliminate housing as an unknown and uncontrolled factor in the studies of poultry nutrition, breeding, production, and disease control. Since housing is known to be more or less closely linked with the control of such diseases as coccidiosis, bacillary white diarrhoea, fowl pox, fowl paralysis, and blackhead, the efforts of engineers in regard to the proper housing of poultry should also be in cooperation with the animal pathologists concerned.

Certain features of poultry nutrition involve especially important problems which might offer worth-while contacts for engineers. The prevention of rickets in young chicks, for example, as studied at some of the experiment stations, particularly the Pennsylvania station, might be of interest in view of the results already obtained by the use of ultra-violet light. Under the rather restricted conditions of poultry production common in the section, cheap and efficient means for natural irradiation of young poultry might be profitably developed. Doubtless this will call for both laboratory and field studies of materials for the construction of brooder and other poultry houses, which will have the necessary thermal properties and yet permit the passage of the necessary light rays. The importance of cooperation with poultry nutrition specialists in work of this character is without question. Furthermore a consideration of the value and profitableness of the industry in prevailing systems of farming in localities, as established by agricultural economists, could well supplement all this work to determine the extent to which improved conditions can be profitably obtained.

CROPS

According to available statistics, the most important and widely distributed crops produced in the section are apples, potatoes, truck crops, small grain and tobacco. Corn, hay, peaches and small fruits also are grown in several of the states, to a greater or lesser extent, depending largely on climate, soil conditions and topography. Pasture development and maintenance also provide a universal problem accompanying the dairying industry.

The production of the several crops involves numerous engineering problems. The more difficult and important of these perhaps, occurs in crop production under medium or small scale diversified conditions where the use of large unit labor-saving equipment is economically impractical.

Apples. Practically every agricultural experiment station in the section is conducting an extensive program of research in pomology, plant physiology, plant pathology, entomology and economics aimed as a whole at establishing the principles governing the production, at a minimum cost, of high-grade apple crops and handling and marketing them at a profit. Studies of orchard management and of the place of an apple orchard in a diversified system of agriculture are numerous, in every instance primary consideration being given to the power and labor items involved in planting, pruning, fertilization, spraying, picking, storage, packing, transportation and shipping.

The pathological and entomological studies which are aimed at the control of scab and other apple diseases and of numerous insects injurious to the apple tree and crop, offer a wide field for profitable engineering activity. The proper projection and deposition of dusts and sprays call for the development of spraying and dusting practices and equipment which will specifically meet the requirements for the destruction of individual insects and microscopic pests. In fact it appears that spraying and dusting so far have been largely empirical and purely mechanical practices. The tendency now is by means of laboratory studies to establish a fundamental relation between the physical properties of the surfaces of the vital organs of insects and those of the surfaces of insecticides, with the idea of developing the physical properties of the insecticides so that when properly applied they will stick and spread on the vital surfaces of insects and produce a maximum kill. In addition, the proper projection and deposition of sprays and dusts call for studies of the physics of these materials under pressure and the logical development of the mechanical principles of the apparatus required for projecting and depositing them as required. Such research calls for the coordination of the highest type of engineering skill with that of horticulturists, entomologists, pathologists and chemists in the identification and proper manipulation of the important physical and mechanical principles involved. A striking example of this sort of work is now in progress at the New Hampshire Experiment Station and other pertinent work has been in progress at the Virginia and West Virginia stations.

The spray residue problem in apple growing is also important from the viewpoint of the engineer. A study of the relationship between the physical properties of apple surfaces and of liquid sprays in endeavors to reduce this residue to a minimum seems a promising line of investigation. The development of methods and equipment for washing apples to remove these residues satisfactorily and economically might also be undertaken profitably by agricultural engineers in cooperation with the agricultural chemists.

Several stations are making efforts to identify the factor or factors governing winter hardiness in apple trees so that it can be reproduced artifically or intensified in apple stocks. The necessity for low-temperature control in this sort of investigation calls for engineering cooperation of a high order.

The storage problem in the apple industry, which is quite general throughout the section, appears to have many phases which remain unsolved. Physiological chemists and pathologists seem to have established rather definitely that apples cannot be stored satisfactorily with

An interesting, although not highly efficient, application of power. This tractor has relieved a team and driver from the dizzy monotony of operating a horse-sweep cane crusher. The front wheels are locked at the angle required to keep the tractor operating in a circle

other crops without some loss, that certain rather definite temperatures and conditions of humidity are desirable for different apple varieties, and that certain storage conditions are favorable and others are unfavorable to certain of the important storage diseases of apples. There is some evidence which also points to the fact that certain types of storage destroy the vitamin potency of apples while others cause them to deteriorate generally in quality. The considerable work of this character in progress at the experiment stations in this region is establishing the bases upon which agricultural engineers can proceed to develop the desired storage structures. The Maryland station, for example, has been active for years in determining the physiological principles of apple respiration and carbohydrate transformation in storage, facts prerequisite to the development of storages providing the proper temperatures and other conditions. Engineers also have an interesting and important problem in developing the use of cold storage to prolong the salable life of appes and in defining the limitations for its profitable adaptation. However, the development of common storages to provide the conditions of temperature, air movement, and humidity required for the satisfactory and profitable storage of apples would seem, under the circumstances, logically to precede the development of artificial temperature control. Close cooperation by the engineers with the pomologists, pathologists, physiologists and nutrition chemists and economists seems to be of the utmost importance in attacking this problem.

Potatoes. The potato industry in the section, while still largely a feature of diversified farming, is rapidly becoming a specialized type of farming in some areas. Regardless of its extent, however, potato production is beset by numerous difficulties and more than half of the agricultural experiment stations in the section are engaged in agronomic, physiological, biochemical, pathological and entomological researches aimed at the production of better and more hardy varieties and varieties resistant to diseases, at the control of diseases and injurious insects, and at the establishment of storage conditions which will prevent loss by spoilage and maintain culinary quality and nutritive value.

An analysis of the production of a potato crop has revealed that engineering is an important factor throughout from the preparation of the seedbed through the planting, fertilizing, spraying, cultivating, harvesting, storage and marketing. The opportunities for profitable participation by engineers in the agricultural researches relating to potato production, therefore, are quite extensive. The preparation of the seedbed as prescribed by potato specialists calls for the development of plowing and seedbed finishing practices and implements which will give desired results at a minimum expenditure of labor and power. Herein lie features of soil dynamics and plow design requiring a manipulation of physics and mechanics by engineers in cooperation with soil technologists. The application of fertilizers, especially some of the newer concentrated materials, offers problems of equipment design which can best be studied in cooperation with the agronomists and chemists to fully meet practical requirements.

Mechanical planting of potatoes appears never to have been perfected to the point at which the seed pieces are placed with precision at the proper depth and spacing in multiple rows. This indicates the need for studies of the physics and mechanics of taking seed pieces from bulk by moving cups or other devices to permit the uniform performance of this important operation in the precise manner prescribed and with a minimum expenditure of labor.

Cultivation of potatoes as a row crop calls now for the development of satisfactory multiple row devices for soil culture which will operate as desired without injury to the plant. The use of a general-purpose tractor in such work with suitable attachments and proper row spacing seems a promising possibility, particularly where potatoes constitute an important element of diversified farming.

Spraying and dusting potatoes for disease and insect control has been dealt with extensively at the experiment stations, usually under the leadership of plant pathologists and entomologists. The physical and mechanical problems of properly projecting and placing sprays and dusts and the development of multiple row and other types of spraying and dusting apparatus are important engineering features of such research.

Harvesting the potato crop, which includes the digging, cleaning, elevating and transportation of the tubers, is essentially a combination of engineering problems most of which have never been solved quite satisfactorily. Investigations in progress at the Pennsylvania station are indicative of what may be accomplished by work in this subject.

The influence of storage and storage conditions on potato quality also has stimulated considerable research at the experiment stations. Maryland station studies on the respiration and carbohydrate transformation of potatoes stored at different temperatures are especially illuminating in indicating the rather definite limitations of storage temperatures which will permit the maintenance of satisfactory culinary quality. Several of the northwestern stations also have indicated that storage temperature and humidity are important in the maintenance of vitamin potency in potatoes.

Since storage often appears to be an important feature in the profitable handling of a potato crop, storage structures should be developed to specifically meet the conditions prescribed by physiological chemists and pathologists for the maintenance of high quality and to minimize

Recent developments in the age-old problem of tillage suggest the importance of agricultural engineers cooperating with agronomists and soil technologists in determining the requirements of specific soils for tillage, as a basis for the development of tillage implement parts

losses. The agricultural engineers must cooperate closely with the physiologists, nutrition chemists and pathologists in order to make the most productive use of the principles of physics and properties of structural materials.

Truck Crops. Practically every North Atlantic state produces truck crops to a greater or lesser extent, especially tomatoes, sweet corn, beans, peas, sweet potatoes and other root crops, and cucumbers. Truck growing ranges from specialized operations on a large scale to average or small scale gardening constituting a feature of diversified farming. The problems of varieties, disease resistance, disease and insect control, seedbed preparation, fertilization, planting, cultivation and spraying are more or less the same throughout the section. The regional experiment stations, practically without exception, are engaged in researches in olericulture, plant pathology, entomology, plant physiology and soil fertility, which are aimed at the production of high quality truck crops at a minimum cost.

The tillage, fertilization and cultivation operations involved in truck crop production in a general way resemble those of potato production, although varying somewhat with the size of the enterprise and the particular crops grown. Offering the same excellent opportunity for engineering participation, they suggest the possibility of developing what might be termed small unit general-purpose machinery for tillage, fertilization and cultivation, which, by the use of different attachments, may be adapted to the needs of several truck crops and also potatoes. The development of the small general-purpose tractor might also be promising in this connection, especially on the average or small scale diversified farms. The Pennsylvania and Massachusetts stations have indicated the possibilities of investigations along this general line.

Most truck crops appear to be planted largely by hand, especially when grown on limited areas. While the operation may vary quite widely with the different crops, the development of small unit general-purpose planters and seeders with seeding attachments for different crops might be an interesting and profitable possibility for saving labor in planting some crops at least.

The diseases of truck crops are numerous and varied and many of the types and kinds of treatment used in their control involve engineering features. The Delaware station found that the control of tomato root rot, for example, calls for the development of spraying and dusting methods and equipment as well as for special cultural practices. The control of downy mildew and leaf blight of cucumbers calls for seed disinfection requiring the development of suitable equipment. The studies of bean anthracnose by the Maryland station show that the disease is spread by cultivating machinery. Indeed they suggest that it may be possible to prevent such spread by modification of the machines themselves. Thus the control of truck diseases is bristling with engineering problems, suggesting the importance of a joint attack by agricultural engineers with plant pathologists.

The control of insects injurious to truck crops presents a rather similar situation. At several of the experiment stations the investigations on the corn ear worm, the Mexican bean beetle, and the potato tuber moth, for example, point to the necessity for spraying and dusting practices which have obvious engineering features.

The storage of certain root truck crops such as beets, turnips, carrots, and parsnips offers problems which in general resemble those of the apple and potato although differing specifically. The Maryland station, for example, in studying the respiration and carbohydrate transformation of such crops in storage has observed that the keeping of each of these crops presents a special problem. Consequently the engineer should know the individual requirements of each crop before attempting to develop a suitable storage.

From the foregoing statements it seems evident that the truck crop situation in the section offers excellent opportunities for profitable engineering participation in the researches on the subject in the experiment stations, and the logical procedure appears to be direct cooperation with the agricultural specialists concerned.

FIELD CROPS

Tobacco. Tobacco production in the North Atlantic states is confined largely to about seven states: Virginia, West Virginia, Maryland, Pennsylvania, Connecticut, New York and Massachusetts. The experiment stations of these states are conducting agronomic, physiological, pathological, entomological and soil fertility studies aimed at the production of high quality tobaccoes at a minimum cost.. Tobacco production in these states varies from large to small scale enterprises and presents numerous problems of tillage, cultivation, fertilization, disease and insect control, harvesting, curing and marketing in which the engineers might profitably become interested.

The opportunity for developing small unit general-purpose tractors and tillage, fertilization and cultivating machinery seems to be an especially promising possibility. The storage and curing seem to raise a question as to the proper construction of tobacco-curing barns. This in turn suggests that the agricultural engineers might well

cooperate with the tobacco specialists in establishing the principles of tobacco-curing barn design.

The investigations at the stations on the control of diseases and insects are also quite extensive and several point to the need for spraying and dusting practices which have obvious engineering features.

Corn. More than half the states in the section produce some corn, usually however, as a feature of diversified farming. The experiment stations concerned are naturally interested in researches to produce better and hardier strains of corn and to determine means of combating diseases and insect pests.

The European corn borer is a problem of some magnitude in several of the corn growing localities, and entomological and agronomic researches to combat this pest are in progress. The part which engineers can take in this work has been well outlined elsewhere and need not be repeated.

The tillage, fertilization, planting, cultivation and harvesting of corn all offer opportunities for engineering participation with particular reference to the development of labor-saving methods and equipment. Here again largely on account of the diversified medium scale farming of the section, the development of small unit general-purpose tractors and machines for tillage, planting, fertilization, cultivation and harvesting might be profitable. The harvesting operation especially seems susceptible of modification through the development of multiple-purpose labor-saving machinery which might, for example, harvest and cut into silage at the same time. Cooperation by the engineers with the agronomists seems quite desirable in such investigations.

Small Grains. More than half of the states in the section produce some small grains, principally wheat and oats, usually as features of diversified farming. Some soybeans are also grown and for the purposes of the present discussion will be considered along with the small grains.

The researches in progress at the experiment stations, especially with wheat, are concerned with breeding for hardiness, disease resistance and other qualities, disease and insect pest control, planting, fertilization, harvesting, storage and artificial drying, most of which offer excellent opportunities for agricultural engineering participation.

Studies in the section on the combine, for example, have raised questions as to the adaptability of this machine to the conditions encountered. In this connection the development of a small general-purpose combine for harvesting the relatively limited grain crops appears to be an interesting possibility. Such a machine would need to be adaptable to all the small grains and beans grown perhaps by the use of different cylinder and concave attachments.

Grain drying also offers an opportunity for engineering activity. It is important that the mechanism of drying under controlled conditions be determined first to provide a sound fundamental basis for the development of practical methods and equipment. Naturally such work should be conducted in cooperation with agronomists and probably also with cereal chemists.

ORGANIZATION OF A PROJECT

Attention has been called above to a few of the outstanding opportunities for engineers to participate in the solution of some of the more important problems confronting the agriculture of the North Atlantic states. Some of the more important points in the organization and planning of a project of engineering investigation, based upon the requirements for engineering participation advanced by one of the above agricultural problems, may be of interest. For illustration, a project already in progress in one of the agricultural experiment stations of the section will be discussed. No attempt will be made, however, to adhere to exact titles or procedure.

For the records of the agricultural engineering department let it be assumed that the project is entitled "The Fundamental Development of a Portable Small Grain Drier." The historical background for the project goes back several years to a finding by farm management studies that the power and labor expenditure in the production of a wheat crop constituted an overwhelmingly excessive proportion of the total cost. Efforts to lower these items by engineering procedure led into the adaptation of the combining practice in cooperation with agronomists and economists. These studies revealed defects in the combining practice which, while apparently saving labor, produced wheat which would not stand storage and was penalized on the market. The necessity for producing a completely cured wheat of superior quality by the new efficiency methods thus became evident. Further studies showed that in order to be practicable the process and equipment for curing should accompany the combine in the field. Thus a rather definite requirement was developed for a small portable grain drying apparatus which would produce cured wheat meeting the quality requirements of the agronomist and cereal chemist. The very nature of the requirement precluded the possibility of completely solving the problem by the mere testing of available drying equipment. It was necessary to establish the principles governing the mechanism of the removal of moisture from wheat in order that the process might be controlled and manipulated with precision to meet the requirements indicated by the agronomist or cereal chemist for any wheat. It was realized that once the mechanism of moisture removal from wheat by artifical means was known it could be duplicated and controlled at will under any conditions and accurate specifications for portable equipment to perform the drying could be laid down.

The organization of the study thus calls for a triple cooperation. The cereal chemist and milling expert are to establish a measure for quality in combined wheat, and the agronomist is to determine what moisture content in combined wheat corresponds to this measure of quality not only with reference to storage and nutritive quality but also germinating capacity. The engineer is to establish under controlled laboratory conditions the mechanism of producing a wheat of the proper moisture content without destroying the other named qualities. From this knowledge standards for comparison will be available for use in tests of available drying equipment.

Thus an agricultural engineering project is evolved which calls for a precise manipulation of physics, mechanics and thermodynamics, which is based on a very definite agricultural requirement, and which calls for a coordination of agricultural engineering effort with the activities of the several agricultural specialists concerned.

CONCLUSION

The above brief review of agricultural research in the North Atlantic states indicates numerous points of profitable contact for agricultural engineering, many of which are rather peculiar to the section owing to the prevalence of medium to small farming units and diversified practices. It does not appear particularly necessary for agricultural engineers to look beyond the existing programs of research in their own experiment stations to find opportunities for profitable research activity. Therefore, the engineers should become fully acquainted with those programs and the agricultural specialists in charge in order to identify the most profitable points of contact and conduct investigations of these features on a fully cooperative basis.

The nature of some of the contacts noted also emphasizes the fact that constructive participation by engineers in much of the agricultural research will demand considerably more than mechanical skill. A knowledge of and ability to use advanced physics, mechanics, thermodynamics, and kinematics seem necessary in many instance to cope with the problems encountered. Advanced training in physics seems especially desirable in this work and this is in keeping with the requirements of other industries.

The Trend in Rural Electrification[1]

By W. C. Krueger[2]

PERHAPS the most lucid index of the trend in rural electrification is evident in the program of this section meeting. Six years or so ago electric uses were of incidental mention. Now there is a distinct rural electrification group in the A.S.A.E. and enough interest in the particular subject to command 12 out of 33 topics presented at this sectional meeting. Rural electrification touches every phase of agriculture, and like the hand of Midas, brings added value to the process concerned. It is not necessary to detail these advantages of electric farm help, rather let us see what we can expect from the future.

Electric uses started with the substitution of electricity for other sources of power and heat; a motor for a gas engine, a hot plate for an oil burner. Then came the period of inquiry into its possibilities, its economic value on the farm, the adaptation of electricity to the then present practices and a program of education for commercial and college men. With this, and as a result of it, has come the scientific study of new agricultural practices and possibilities. All three of these phases are merged in our present status in rural electrification. To project a line one must have a backsight; and to determine the trend in this branch of agricultural engineering we can review its present development from the standpoint of (1) farming practice, (2) the power companies' program, (3) the various states' projects, (4) the manufacturers and (5) the research possibilities.

The progressive farmer insists on electric service, from high line or from home electric plant. About 10 per cent, or 389,000 American farms have central station service. At least an equal number have private plants. Indications are that another three or four years will bring high line service to the 1,000,000 mark. Allowing a minimum investment per new customer of $720 we get an impressive total of 72 million dollars per year spent in wiring and equipment by farmers alone. It is proving a profitable field for equipment sales.

Rural electrification increases the independence of the American farmer. Always individualistic; he now is on a par with his city brother in comforts and conveniences, and the passing of the crossroads blacksmith and carpenter shops makes independence more necessary. Ready power and good equipment is bringing the grinding back to the farm, and making the threshing, silo filling and wood sawing less and less custom jobs. Many farmers are using over 3000 kilowatt hours of electric energy a year, and justify it. With the average farm usage around 500 hours, we can see the possibilities in developing a load, 600 per cent increase is not too high a goal. In several instances where a definite community effort has been made to increase usage, a 100 per cent increase has been obtained in one year. We can expect the load on farms to build up at an ever increasing rate. Farm youth is becoming electrically minded and the user of the future is the curious and experimenting youngster who now shorts batteries, unwinds coils to see how they work, or uses the electric iron for a "play boiler." A little boy was ready for bed, one evening, and after saying his prayers and "amen" added "This is Oswald speaking." Familiarizing boys and girls of today with electric uses is selling the user of tomorrow.

A most powerful influence in rural electric development is and has been our colleges and state committees. To them is due credit for much of the initial research and developmental work. They established the electric farm help as economically practical. They developed equipment, collected data, pointed the way for manufacturers and power companies. From research and fact finding the trend now is toward straight extension work, the education of the farmer in the use and advantages of electric help. Research still is necessary and forms a part of most programs but there has been a very noticeable change the country over, away from test farms, meter records, loaned and experimental equipment toward pure extension programs.

Rural business presents the greatest single sales field left in America for electric power and equipment and, in general, the utilities have come to regard it as the next step in the expansion of their business. Six years ago most were scoffing, then in turn they were skeptical, doubtful, apathetic, curious, interested, optimistic, and enthusiastic. Now many are following an aggressive program of rural electrification. Line extension policies have become more liberal. Line costs have been reduced, but it is still a problem to reach the scattered farms. Longer spans, bare wire, modern construction machinery, all help reduce costs. A tendency to equalize extension costs by operating over longer areas is shown in a Minnesota attempt to electrify on the township basis and in Indiana where an entire county is under survey.

Rates and rate structures have experienced marked changes during the past few years. The tendency appears to favor a one-meter rate, a simple rate structure easily explained; a block or step rate that induces increased use at low charges, including a service, demand or minimum charge based on the normal use, and measured by the capacity of the company to serve. There appears to be a decline in the use of the straight monthly connected horsepower or kilowatt charge, which tends to penalize progress and hinders equipment sales.

Rural service and sales departments characterize those companies leading the way in rural electrification. A definite increase in energy sold is noted where the rural service departments are active. There is a need for men capable of handling the farm electric problems. College agricultural engineering departments are meeting the de-

[1]Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers, at Amherst, Mass., October, 1929.

[2]Extension specialist in rural electrification, New Jersey State College. Assoc. Mem. A.S.A.E.

Electric uses started with the substitution of electricity for other sources of power and heat . . . . Then came the period of inquiry into its possibilities—the adaption of electricity to the then present practices and a program of education for commercial and college men. With this, and as a result of it, has come the scientific study of new agricultural practices and possibilities.

Along with the perfecting of present uses should be included a more basic study, an inquiry into these last mentioned electric phenomena, a determination of the "why" as well as the "what." This intelligent and directed curiosity to determine the possibilities in these newer electrical applications seem the most pronounced single trend in the rural electrification of today.

mand with courses in electricity and its application on the farm. A successful attempt has been made to teach this in Smith-Hughes schools and country night schools.

Manufacturers have contributed materially to this growth in rural electrification. Electric motor drive requires changes from engine or hand drives, electric drive and control makes easy the uses of equipment, otherwise difficult. The present development of hammer feed mills and mixers was directly influenced by electrification. The same is true of water supply systems, chore motors, dairy refrigeration, sterilization, later types of milking machines and ensilage cutters. There is roon for the development of a standard merchandizing policy with regard to agricultural equipment. Companies do not wish to encroach on plumbers or implement dealers territory; still they often find it desirable to handle such outside equipment in order to build loads. Fortunately a committee on electric farm equipment of the National Electric Light Association is working on this merchandizing problem, and recommendations are forthcoming for standardizing methods in electric farm equipment sales. Some manufacturers have met the problem by changing their sales organization to cooperate directly with the power companies in sales.

I look for a rapid development in new and more specialized farm equipment. The sandblasting of eggs in the East only awaits cooperative efforts of poultrymen and eliminates dirty eggs and the basement sponge or jacknife. Battery brooders are increasing in popularity, yet need standardization of heating and ventilating equipment and control. Custom hatching in some sections is rapidly displacing the practice of home incubation. We see noteworthy changes in mammoth type incubators and a prononunced tendency toward the "all electric type." The latest attempt I have heard of is an electric, continuous incubator, conveyor principle, automatic with graduated heat. House heating with electricity may be nearer realization than many appreciate. Developments in radiation systems and insulation, air conditioning and humidity control bring the possibility nearer. Twelve houses electrically heated proved satisfactory in a recent test, cost was excessive except on the very low experimental rate, and on that basis compared with coal. Dairy refrigeration has received as much time and thought as any electric farm use, still there is controversy regarding methods of cooling and handling, tanks, type of storage, etc. The individual farm, differences in milk and selling systems delay an approach to standardization of equipment. An easily shipped, inexpensive, moisture proof, insulated holding tank is needed, adaptable to the several cooling systems. To insure that milk stays cold on the trip to the plant, trucks should be refrigerated. There is room for improvement in aerator connections to facilitate ready removal for the stationary aerator is often poorly cleaned and high counts result.

Milking systems show interesting development. The Walker-Gordon adaptation of the New Zealand system is one example of a tendency to improve equipment in the elimination of hand labor and to insure cleanliness.

There is a trend toward closer coupling between machines and power, direct-connected drives, an increase in the automatic operation and control of farm machinery, (opposing individual drive is mainly the monthly service charge based on horsepower) and a marked development in specialized equipment for processing farm products.

However, it is in the possibilities for new uses and applications that we can look for the most revolutionary and far reaching development in the use of electricity in agriculture. Scientists are just beginning to appreciate the inter-relationships between the various forms of electric energy, light waves, ether waves of higher and lower wave lengths and frequencies, X-rays, ultra-violet rays, and their effects on and relation to plant and animal matter. In this strange field lies a power that inhibits or energizes, stimulates or destroys. Granting that consideration of these forces as applies to agriculture is visionary, the possibilities remote and claims grotesque; can we afford to ignore the effects of workers in this field, however unscientific their technique; dare we close our eyes to the future or shut out by ridicule and skepticism every inquiry into these little understood fields.

Professor Steinbach's discovery of the principles of vitamin D fixation by ultra-violet rays has opened unfathomed possibilities in the vitalization of foods. The application of this treatment to farm produce, on the farm or at delivery points, is not too remote for serious consideration. Irradiation of milk, butter and food stuffs is already practiced. The problem of azone tainting the milk when treated by irradiation has been met by treatment in a bath of inert gas, carbon dioxide being the most commonly used. There seems to be some confusion regarding the milk sterilizing possibilities of ultra-violet rays. I am informed by good authority that the rays cannot penetrate a film of milk, yet we have reports that ultra-violet ray sterilization is offered the market.

Dr. Munn of Fort Atkinson, Wisconsin, has done considerable work with ultra-violet rays on contagious abortion. There is a possibility that the use of these rays may stimulate animals and help overcome diseases. Reports indicate that results so far have not been decisive.

Irradiation of chicks and hens is commonly practiced. Cod liver oil or irradiated food gives the same results. It is still in the "prescription" class so far as general application in the hands of inexperienced operators goes. Over treatment is as deleterious to production as lack of treatment.

Experiments with X-rays indicate interesting possibilities. Some suggestions seem far fetched, others possible. Paul Hadley of New Jersey, an experimenter, reports that regulated X-ray application weeds out male from female eggs, by differential killing of the germ cells. Sterile eggs are possible by longer treatment, preventing spoilage through germ development. The Canadian Ministry of Agriculture is investigating these claims.

Dr. Muller's work in Texas on the mutations of fruit flies is of far reaching importance. He has shown that hereditary tendencies can be changed by X-rays. The chromosomes are forced apart and permitted to re-assemble with different genes so resulting in new characteristics. This principle if it can equally be applied to seeds, to animals and insects is of economic importance in rapid

development of new strains. It saves years of waiting for a chance "sport" that carries desirable characteristics.

In Italy pollen was subjected to an electrical discharge, with resultant changes in the color, size and shape of the resulting plants.

Seed treatment has received a lot of attention. The Carr-Bennett system of seed treatment is said to give excellent results in increased yields and vitality. The seeds are soaked and steamed, spread out on a zinc sheet and rolled with a glass vacuum cylinder flourescest by having a high frequency current passing into it. The other terminal of the generator is attached to the zinc sheet.

The Wolfryn electro-chemical seed treatment is another development. The seeds are subjected to a current of 2 amperes per square foot of electrode surface while in a bath of mineral salts of fertilizing value. In Oregon, an electric spray system is being tried. A network of wires carrying high frequency, high voltage current is mounted above the orchard trees. Reports state that fruit is evenly colored, insects stay away, disease is less, foliage better. Dr. Stadler of Missouri has studied disinfection of seeds by X-rays. Also mutations in seeds and birds.

Utilization of earth currents for plant stimulation dates back 150 years. Interest of course is now stronger than ever, and although no experiments, so far as I know, have been conclusive, the systems show enough results to warrant careful study.

Justin Christ of Leau offers a system under his name that has commercial recognition on the Continent. As I understand it wires buried in the ground, parallel to compass lines, terminate in north and south "gatherer" poles. A similar system, but using overhead wires with drops touching the plants to be treated, is reported. Considerable interest in this manner of plant stimulation is shown in Europe, while here the work has tended more toward electro-culture using electric discharges. The theory of the latter is that an electric field increases chloraphyll activity and faster utilization of plant food results. Some benefit is believed to result from nitrogenous substances formed by an earth discharge through plants since those with pointed leaves benefit most.

Electric cultivation is represented by the Roe plow, and by the Synmotor system of motored field cultivation. The Iowa manless plow, the new automatic tilt plow, cable plows and improvements in cables, trolleys and controls bring electrified cultivation ever nearer.

For some years I have pictured in mind electric sterilization of hothouse soils and tobacco seedbeds, electric substitution for the ever-increasing sprays and dusts on fruit and vegetables. Recently reports from Continental physicists and biologists indicate the possibility that living matter emanates a wave form of energy having a definite frequency and length. By imposing a wave slightly out of beat we might possibly get a stimulating or a lethal effect, with the likelihood that plants and animals react in different frequency zones and the chance therefore of differential treatment.

One of the most interesting studies that has come to my attention is reported in the Journal of the New York Entomological Society, Volume 37, March 1929. Insects were killed by subjecting them to a wave of 24 meters and about 12,000,000 cycles passing between two aluminum terminal plates. A summary of the experiment state, that this lethal effect is due to the development of an internal heat of a lethal degree; that the insects' nervous reaction speeds up the rate of producing this heat and that the degree of reaction is directly proportional to the specialization of the nervous tissue, that all organic chemical compounds react with increases in internal heat to high frequency waves, but that cholesteral is supreme in reactance of all the compounds tested, and finally, that cholesteral is characteristic of nervous tissue.

This is a start in the type of research work that will lay the foundation for the new developments in electric applications.

The National Electric Light Association, the Committee on the Relation of Electricity to Agriculture, our state colleges, manufacturers, power companies, the American Society of Agricultural Engineers and many other agencies have contributed and are responsible for the present development in rural electrification. The work will be continued, but along with the perfecting of present uses should be included a more basic study, an inquiry into these last mentioned electric phenomena, a determination of the "why" as well as the "what." Too often the machine or the process is presented first; then studied to see why it did or did not work and how. Let us reverse the order, find out why, and build our research on solid ground. This intelligent and directed curiosity to determine the possibilities in these newer electrical applications seem to me the most pronounced single trend in the rural electrification of today.

Corn Borer Control Machinery Demonstrated

BEFORE a group of about one hundred agricultural engineers and representatives of the farm implement industry, demonstrations were held on the government farm at Toledo, Ohio, on November 7, of the use of machinery in controlling the European corn borer. It is now generally recognized that machinery offers the most hope of any of the control methods so far tried.

The agricultural engineers present were chiefly heads of agricultural engineering departments of the state agricultural colleges of regions now infested or expected to be invaded within the next few years. Representatives of the farm implement industry were largely from organizations that have cooperated to a greater or less extent in experiments that the Division of Agricultural Engineering, Bureau of Public Roads, has been carrying on at Toledo for the last three years. The purpose of the demonstrations was to show to these visitors the actual operation of machinery and to explain, at the same time, their particular points of effectiveness in reference to corn borer destruction.

Machinery demonstrated was of two general types, namely (1) implements that the farmer regularly employs in cultural and harvesting operations, and (2) devices the specific object of which is to destroy the borer.

Some of the tillage and harvesting implements demonstrated were operated as they come from the manufacturer. Others had been rebuilt more or less and carried attachments developed by the Department's engineers at Toledo, that had particular application to corn borer destruction. Among the implements of this type demonstrated were various types of plows designed to give complete coverage of standing stalks; standard makes of corn binders and ensilage harvesters provided with attachments for cutting the stalk at the ground surface; sled, wheel and hand-operated types of stalk shavers that cut at the ground surface; dump and side delivery rakes for cleaning up the ground. The class of machines developed specifically for corn borer destruction, and which are at the present time in purely an experimental stage of development, included three types of mobile field burners using oil, and a mobile steam sterilizer for destroying the borers contained in the refuse.

Prior to the field demonstrations the party met at the corn borer control headquarters at Toledo and were addressed briefly by C. O. Reed, professor of agricultural engineering, Ohio State University; L. H. Worthley, Plant Quarantine and Control Administration; D. J. Caffrey, Bureau of Entomology; and R. B. Gray, Division of Agricultural Engineering, Bureau of Public Roads.

Construction of Milk Cooling Houses and Insulated Tanks[1]

By F. W. Small[2]

FOR the past fifteen or twenty years milk inspectors, health officers, dairy specialists, milk dealers and others in New England have been striving to get dairy farmers to take better care of their milk. Progress has not been rapid. The general feeling has been that the desired results should be brought about gradually so that the farmers might meet the requirements with a small expenditure. There was also the probability of a milk shortage if the standard which all dairy men must meet was set too high.

During this time the Dairy and Food Council did excellent work in getting the public to use more milk and the per capita consumption increased rapidly. But while this was going on the public was learning to be more discriminating about its milk supply. It wanted milk from tuberculin tested cows. It wanted clean milk with a low bacteria count, and more of it. Milk came in from the Middle West in glass-lined tank cars. It was of superior quality. It satisfied the demand.

Then was the time to make stronger milk regulations, and the time for the New England farmer to wake up and meet competition such as he had never known.

Milk regulations which came into being in several local cities within the past two years have brought about a wonderful transformation and many milk cooling houses and tanks have been built during the past ten months.

Location of Milk House. The milk house should be located on well-drained soil if possible. It should be near enough to the barn for convenience in doing work but not opening directly into the barn.

Size. The size of the milk house depends on the number of cows kept and also on whether both milkings or only the night's milk are to be cooled. It is usually made wide enough to accommodate the length of the cooling tank, and where mechanical refrigeration is to be employed, allowance must be made for the compressor. Generally speaking, the house should be large enough to provide room for the cooling tank, compressor, cans and pails, but should not be so large as to invite the storage of other things. A milk room should be used exclusively for milk and cream storage. I have seen milk houses as small as 4x6 feet and as large as 20x20 feet but the average is probably about 8x10 feet. The height from floor to plate or ceiling should be at least 7½ feet.

Construction. The foundation and floor should always be of concrete. Concrete is desirable because it is relatively cheap and durable, does not absorb odors and is easily kept clean. The floor should not be laid, however, until the cooling tank has been installed, because the tank bottom should be below the floor level. Cement blocks make a very attractive milk house, and one that is permanent and sanitary. Where frame construction is employed it is better to carry the concrete wall up to about thirty inches above the point where the floor level is to be. This eliminates the rotting of studding and provides a wall that can be washed down when desired.

Foundation walls for milk houses need no extra width of footing but should extend below frost line and be from 6 to 8 inches wide. The floor should be separate from the walls and from the tank to prevent cracking.

It is best to use standard width doors and windows. For convenience the door is placed at the end of the house nearest the stable and the milk tank across the opposite end. If of frame construction drop or novelty siding is suitable, also vertical dressed tongued-and-grooved siding. The window area should not be less than 10 per cent of the floor area. Sheathing on the inside provides a surface on which cobwebs and dirt do not readily accumulate and is very desirable. The interior should be whitewashed or painted, depending upon the construction. Cement asbestos shingles are used where a permanent and fireproof roof is wanted.

Little more need be said about the construction of the milk house since it is so similar to any other small building. Of course it is well to provide a drain to take care of the water from the cooling tank and from the floor of the room. Milk spilled on the floor can be flushed down with water if a drain has previously been installed. Windows and ventilator should be screened to exclude flies

Construction of the Cooling Tank. There are a number of ready-to-install milk cooling tanks on the market all of which will do a good job, I believe. But when the farmer compares the cost of these with what it will cost him to build one of concrete, and further considers the long life of a concrete tank, he is likely to build his own or hire somebody to do it for him. He is further satisfied when

[1]Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers at Amherst, Mass., October, 1929.

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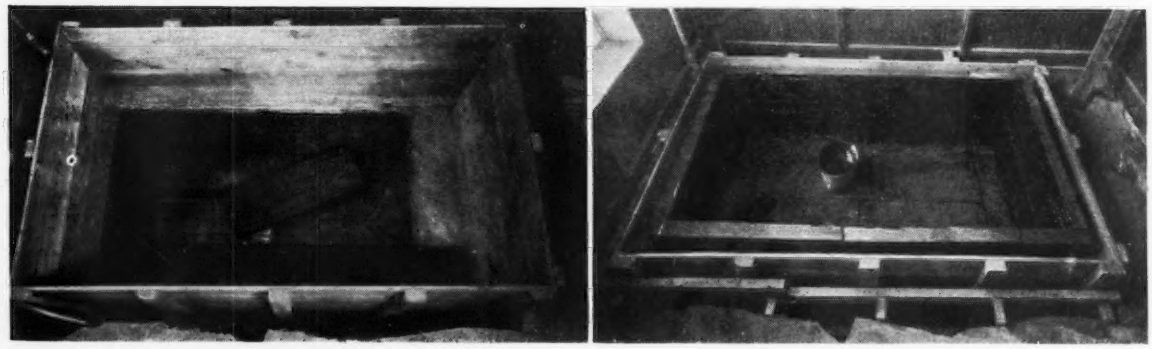
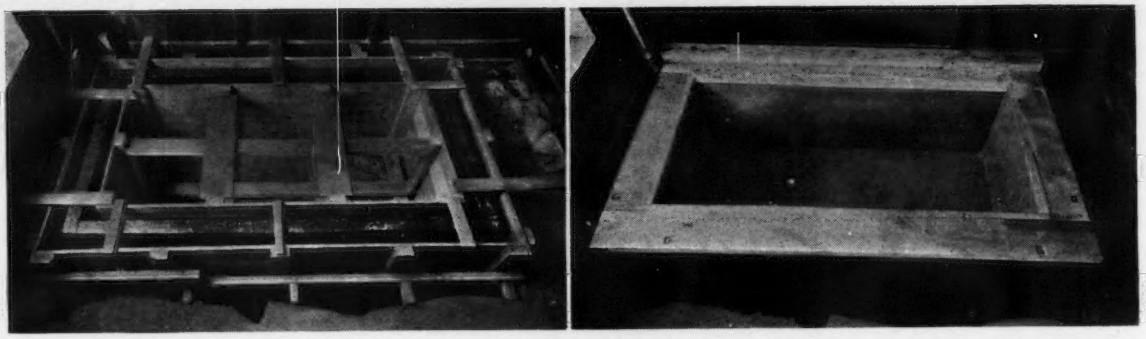


(Left) Exterior form in place for building an insulated tank. This view also shows the commerical cork board base insulator. (Right) Insulating cork board walls mopped with tar and set, with a 3-inch space between it and the outer form



(Left) Both inner and outer forms in place ready for the placing of concrete. In placing, the mixture should be kept at about the same height on each side of the insulation, to avoid displacing it. (Right) The completed tank. Bolts are set in the concrete for attaching the cover

he learns that concrete tanks can be built for use with ice or with mechanical refrigeration.

The first step in building a concrete cork-insulated tank is to decide upon which of several methods of construction will be used. Regardless of the method of construction, it is desirable to have the tank set into the floor so that only about sixteen inches of its height are above floor level. This facilitates the lifting of cans into and out of the tank. The second step is to dig the hole in which the tank will be built.

There are metal tanks on the market built to be used as inner linings for concrete tanks. These tanks come fitted with connections, and with holes drilled ready to connect with coils and compressor. This eliminates mistakes that a farmer might make and requires less time of the men who install the compressor. Installation of these tanks is very simple. A concrete slab is laid in the hole and sheet cork which has been treated with asphalt is laid on it. Cork should be protected with asphalt on both sides and all edges. The tank is now placed on the cork-covered slab and cork is stuck to its sides and ends, being held in place by the asphalt. A form is erected outside the cork, and concrete is placed around it.

Probably the easiest method of building a concrete tank where no metal lining is used is as follows: A concrete slab four inches thick is laid first. This slab should be at least twenty inches wider and twenty inches longer than the desired inside width and length of the tank.

Cork is laid on the slab over an area equal to the bottom of the tank. This should be asphalted thoroughly top, bottom and edges. The side and end walls of cork are now erected and asphalted. Thus we have a box made of cork sitting on a concrete slab. Inside and outside forms are erected and concrete placed either side of the cork. Care must be taken not to displace the cork or injure the film of asphalt on it.

In what I consider the safest and best method the outer concrete tank is made first. It must be separate from the foundation wall to prevent cracking. Lumber used in form construction is cleaned to be used later for making the inner tank.

The outer tank is given a cement wash on the outside and an asphalt coating on the inside, and care is taken to see that the concrete is tight around the outlet drain pipe. It is well to pour hot asphalt around this joint. This drain should be installed before the concrete is placed, and the upper end should extend up into the tank six inches above the floor level of the outside tank. When three inches of cork and three inches more concrete are placed, the end of the drain will be flush with the floor of the tank.

With the outside tank completed sheet cork three inches thick is applied to the inside walls and floor. Cork should be dipped in hot asphalt and brushed to eliminate bubbles. It is applied while the asphalt on it is still hot. The cork should then be given another coat of asphalt and be covered with an asphalt saturated rag felt (roofing felt) or woven cotton fabric. It is important that the cork be given one hundred per cent protection against moisture, therefore, in addition to the asphalt coating and asphalt-treated cloth, care should be excercised not to let cloth draw across corners where it may become punctured when the concrete is placed.

Having completed the waterproofing we are now ready to place the concrete for the inner tank. The inner form which was made by cutting the outer form down is suspended in the tank and concrete is placed between this form and the cork, taking care not to damage the asphalt cloth which covers it. The concrete floor which is placed at the same time should slope gently toward the drain pipe and be flush with it. The overflow pipe should be 20½ inches high in order that the water may come up well around the necks of the cans. Two-inch wrought iron pipe should be used.

In all three methods described, bolts are inserted in the concrete for the purpose of fastening down the plank to which the cover is hinged. This plank may be covered with metal or channel iron, to prevent swelling and splintering.

Where spring water below 50 degrees (Fahrenheit) is available for cooling, no insulation need be considered if such a supply is certain even in the hottest weather.

Cork board is the insulation recommended. It comes in sheets 12 inches wide, 36 inches long, and in thicknesses of from one to four inches. Three-inch cork should be used in the walls and floor of the tank, and two-inch cork may be used in the cover. The price of cork is constantly changing, but ten cents a square foot per inch of thickness is about an average price.

The Cover. Some covers are made by constructing a frame of two-by-three lumber, filling this with two-inch cork, covering the bottom with galvanized iron and the top with sheathing. Whether this cork in the cover is quite necessary I do not know. Many have built covers with two thicknesses of building paper between two thicknesses of matched lumber. The cover will be heavy and a weight and pulley should be provided for convenience in raising it.

Some of the reasons why a dairyman should have a covered concrete, cork-insulated tank are:

1. Milk is cooled with half the usual amount of ice or electricity
2. Milk is cooled 10 degrees lower than with the ordinary tank
3. Milk is cooled in half the usual time
4. Milk is cooled in winter as in summer
5. This type of tank will not freeze, rot, rust or need replacement
6. It can be constructed at a convenient work height
7. It can be constructed for a small cash outlay
8. It will pay for itself quickly
9. It will retard bacterial growth in milk
10. It saves labor and time.

Spraying From Stationary Plants[1]

By E. R. Gross[2]

PROBLEMS in the control of diseases and insects, timely application of sprays, complete coverage, the cost of labor and labor required for spraying operations have created much interest in spraying from a stationary plant with pipes and outlets permanently installed in the orchard. At first it would seem that the cost of such a plant and the piping of the orchard might considerably exceed the investment in portable rigs capable of doing the same work. However, several western states have preceded the east in the use of stationary plants and they find that the cost may even be less. It seems that in large bearing orchards requiring heavy applications of spray material in limited periods of time, where long hauls with the empty spray rig involve a considerable waste of time and where several portable rigs would be required to do the spraying effectively within the limits of time, the stationary installation is a profitable investment.

Since the spring of 1927 stationary spraying plants have been rapidly gaining in New Jersey. Prof. A. J. Farley, extension pomologist, New Jersey State Agricultural College, in speaking at the last meeting of the Pennsylvania State Horticultural Society, said that the installation of plants this year would bring the number in operation up to seventeen, covering between 1200 and 1500 acres. I am reasonably certain that all the contemplated plants were installed and that others have been added. I have been consulted with reference to several installations had completely planned one.

Stationary spray plants do not differ materially in principle from portable rigs. The operating pressure may be higher in order to allow for greater friction losses in long pipes and hose. The power plant must usually be larger to take care of this increased pressure and to provide enough flow to supply the required number of guns. Some problems arise, such as the possible settling of material in the pipes, draining pipes to prevent freezing, cultivating around the outlets, possible leaks, etc.

These plants may be classified according to location and arrangement of pipes into overhead systems, underground systems, dead-end systems and return systems. Four possible combinations of these classifications may be made. For example, underground return systems. All these combinations are found in satisfactory use. The final choice usually depends upon the desire of the grower based on his conditions.

It seemed obvious that return systems might have an advantage over dead-end systems especially when handling a liquid carrying suspended spray material. Hence, the first growers in New Jersey to install stationary spray plants used return systems. This was thought particularly necessary when using such material as the "New Jersey dry mix" but dead-end systems now seem to give equally satisfactory results. Hence all the later plants are of this type. In view of the difference in cost for extra pipe and labor this seems wise.

The advantage of overhead systems about balance those of the underground type. Each seems to have its place though there is quite a tendency toward the overhead type among growers who have recently installed systems in New Jersey. The advantages commonly claimed for the overhead type are: (1) It is easy to locate and repair leaks, (2) it is easy to drain the pipes and (3) it requires less labor for installation. Those who favor underground systems claim that: (1) Fewer leaks will develop, (2) there is less interference with cultivation and other operations and (3) it is a more permanent job. No doubt under some conditions one system would of necessity be selected. This might be the case in extremely rough or stony ground where it would be quite impracticable to use the underground system.

The amount and size of pipe necessary depends upon the size of the orchard and the arrangement and the size of spraying blocks. As much as 1500 feet of ¾-inch pipe may be used in one lateral provided the plan of spraying will not draw from too many outlets at the same time. Thus most of the pipe will be of small size. One 55-acre orchard required 7500 feet of ¾-inch pipe and 2000 feet of larger pipe ranging from one to two inches in size. In this case the total cost of piping, outlets and fittings was $900.00, or $16.00 per acre. The orchard shown in Fig. 1 has an area of about 90 acres and required 10,000 feet of ¾-inch pipe and 2,700 feet of 1-inch to 2-inch pipe. There is a growing tendency in New Jersey to place both laterals and outlets closer together, thus reducing the size of spraying block and the length of hose used, and reducing the spray crew to one man. The argument is that the added expense of installation is saved in reduced labor within a period of a few years. Some of us may feel that short hose lengths with one man, the gunner, dragging his own hose may not be the best policy, but we cannot overlook the growers experience. He is meeting a labor problem we may not fully comprehend.

Two things materially affect the size pipe which is best. Small sizes introduce heavy friction losses but give a rapid flow and avoid possible settling of spray material. Larger pipe do just the opposite, that is, they reduce the friction losses by slowing up the flow to the possible danger of settling and stopping of the pipes. We may some day find the best size for given conditions. For the present the sizes used seem to prove at least within the range of practicability.

The kind of pipe is not a serious problem but requires some thought. Some have used black iron pipe on the assumption that it rusts chiefly from the inside and therefore is best because is cheapest. Others assume that first cost is, in the end, a small item and therefore wish to use the best for permanent installation. They will want galvanized pipe or copper alloy pipe which is now available at only a little higher cost.

It is already pretty generally decided that ¾-inch pipe is the smallest desirable size. The hose must be of the high-pressure type. It may vary in length from 100 to 300 feet according to the spray crew of from 1 to 3 men. I feel that I voice common sentiment when I favor ½-inch hose rather than ⅜ inch. Since hose will last only 2 to 3 years it is well to provide for repairs which can best be made with standard connections. With soft wire a standard connection can be made to hold the pressure.

I feel that the pumping plant may be passed with only a few remarks. An ample supply of water is absolutely essential. Even a small plant may apply 10,000 gallons in a day and larger plants go as high as 25,000 to 30,000 gallons. Water for mixing should flow to the tank by gravity in order to save time. The supply may readily be pumped to an elevated supply tank. It is necessary to have a pump of correct size and enough power to drive it. A safe calculation is based on 7 gallons per minute from each gun. On this basis a 30-gallon per minute pump will easily supply four guns and usually it is made to carry five. It is not unusual to see plants in New Jersey with pumps of 50 to 60-gallon per minute capacity.

Two tanks of 300 to 500-gallon capacity are used, one for mixing, the other to draw from while spraying. For

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[1]Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers, at Amherst, Mass., October, 1929.

[2]Professor of agricultural engineering, Rutgers University. Mem. A.S.A.E.

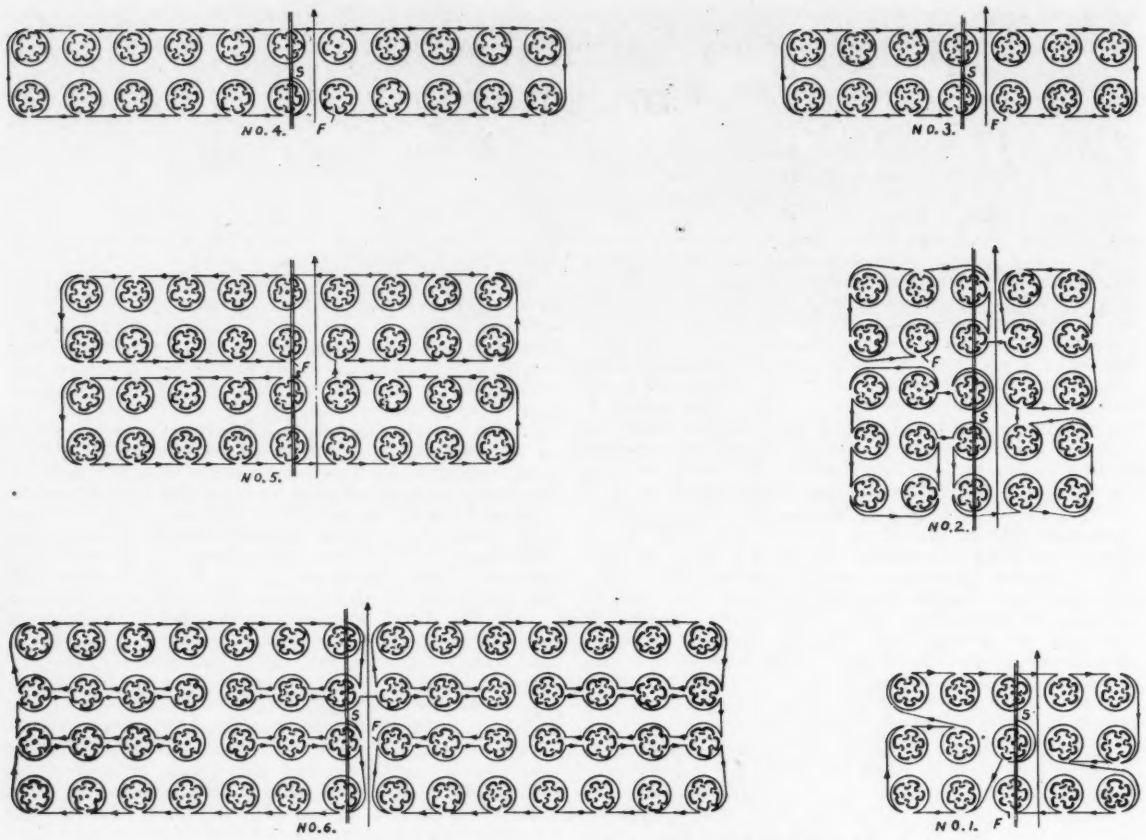

Fig. 2. Layout of spraying blocks and order of spraying trees in each type of block

uniform spraying pressures the spray tanks should be slightly above the pump. Tractors, gas engines and electric motors are used for power. Since a high pressure (450 pounds) is desirable ample power must be provided One 30-gallon per minute pump was found to require a 10-horsepower motor.

The spraying block or order of spraying trees is of considerable importance. I have gathered six plans which are shown herewith. They consist of two block methods and four row methods. The blocks are 3 trees by 5 trees and 5 trees by 5 trees. The row methods use 2 or 4 rows on each side of the lateral. They differ in the length of row or the distance travelled away from the lateral and in the exact order of reaching trees. Whether 3, 4, 5, 6 or 7 trees constitute a row depends upon the length of hose used. My contact with the work convinces me that the simple method of going up one row and down the next is most effective in avoiding the possibility of missing trees. Whether two rows or four rows are sprayed from one outlet makes only a little difference in hose length. I think that the 3-by-5 and 5-by-5-tree blocks introduce extra travel, as also does the order shown in No. 6, Fig. 2. Nos. 3 and 4 differ only in length of row for one-man or two-man crews.

Proper operation of the system requires close attention until men are familiar with the routine. All mains and laterals used each day should be flushed by pumping clear water during the last few minutes. Each lateral must be flushed at the extreme outlet used that day. Valves on the laterals may be kept closed if the lateral is not used.

Accessories which have not been mentioned are an air-chamber or standpipe on the main or at the pump. Globe valves seem to be as well suited as any type. Unions should be of the ground type and plenty of them should be used to aid in repairs as leaks occur.

In the end a grower will decide many of these questions according to his conditions. If he is in need of new spraying equipment and wishes to make heavy applications in a large bearing orchard with only a few days to do it he may well consider a stationary spray plant. He may find that it will cost no more than portable rigs capable of doing the same work.

Pump Irrigation Gains Favor in Corn Belt

FARMERS in the western corn belt, who have witnessed pump irrigation of corn, potatoes, and other field crops in that section, are watching the development of this practice with expectancy. The success of quite a number of practical farmers who have tried out pump irrigation, points to its further adoption on a larger scale in the next year or two.

Pioneers of irrigation in the great plains have used two methods, (1) sinking large wells and securing water from underground, and (2) pumping from open streams. The former plan is of course the only one which can be adopted on an extensive scale, because of the limited areas located on creeks or rivers.

In central Nebraska, several farmers have successfully irrigated their farms from wells, pumps which will deliver around 2000 gallons per minute being commonly used. These men feel that every year they have an opportunity to use their outfits profitably, even though there may only be a short drought.

Economics of Farm Structures and Equipment[1]

By V. B. Hart[2]

THE importance of having barns near crop fields was not realized by our forefathers. The homestead was usually located up on a hill where they could "see out well" or else "down in a hollow where the wind didn't get you." Putting the buildings up on a hill frequently meant that they were at the greatest possible distance from the crop fields and putting them down in the hollow often meant that when the timber was cleared from the hill tops, the crop fields were again at a considerable distance from the farmstead.

Present high cost of man and horse labor make it more than ever important to have barns conveniently located. Cost accounts kept on New York state farms indicate that with a five-year rotation of corn, oats, wheat and two years of hay, in order to work a 10-acre field one-half mile from the barn, it will require an average yearly travel of 66 man-miles and 150 horse-miles. Assuming that an average man and team make 3 miles per hour, this means 22 man-hours and 50 horse-hours. If we figure man labor at 40 cents per hour and horse and equipment at 30 cents, this means that $23.80 worth of time is spent per year in going back and forth between barn and field. This is an annual cost of $2.38 per acre and $2.38 is interest at 5 per cent on $47.60.

Every extra half mile that a field is away from a barn makes it worth $47.60 less per acre. Or, since we are supposed to be approaching the problem from the standpoint of the barns, the placing of a barn one-half mile away from the crop land makes it really worth nearly $50 less for each acre of crop land that the barn serves. With more intensive crops than those included in the rotation used in the example given, there would be still more loss.

The old farm management rule for locating a set of farm buildings was "as near the center of the farm as possible and still be on a road." With the rapid introduction of automobiles and trucks we should probably say, "as near the center of the farm as possible and still be close to an improved road." Traffic is frequently so heavy on our through roads that the farmstead might better be just off a main artery of travel on a good gravel road than right on a concrete boulevard. This is especially true if the farm lies on both sides of the road.

Proximity to the crop fields is more important than proximity to town or the pasture land. An extra half mile to town can be covered more rapidly with a car than an extra half mile to the field with a team or tractor and the time of a cow walking to and from a pasture should be worth much less than that of the man who owns her.

Saying that barns should be conveniently located raises the question of what the person is going to do who has a set of buildings that are stuck on the far corner of the farm. The land can't be moved in nearer to the barns and moving the farmstead is usually too expensive to consider. It may sound like a highly theoretical idea but there is absolutely no question but what many farmers would be better off if they sold off some of their more distant fields at a low price, or in many cases, gave them away, and bought land nearer to their buildings. With an extra value of $50 per acre accruing to a field right adjoining a farmstead as compared with one a half mile away, it is sound farm management to sell and buy crop land so as to put the buildings near the center of operations.

For saving of labor and general convenience the house and barns should be from 120 to 200 feet apart. One of the greatest mistakes made at present in locating new barns is to put them too far from the house. Every extra 100 feet of distance between house and barn on a three-man crop and dairy farm means about 400 extra miles of travel per year or a loss of at least 100 hours of time worth around $40. This is interest on $800. Every extra 100 feet of distance between house and barn on a good sized crop and dairy farm costs $800. Having barns too far away from the house has also frequently meant the loss of a good horse or cow because no one heard it when it needed attention. From a farm management and domestic standpoint the barn should be just as near the house as possible and still be far enough away so you can stand in the woodshed and not confuse the smell of the manure pit with the bacon frying in the kitchen. This usually means from 120 to 200 feet.

Farmers and some insurance companies lay too great emphasis on having buildings scattered on account of the supposed lessening of fire risk. We can take an excellent lesson on economy of labor versus fire risk from our friends in northern New England who have the house, the L, the shed, and the barn, all connected. I believe statistics do not indicate any larger farm fire losses or higher insurance rates in northern New England than in other north Atlantic states. Fire insurance is usually cheaper than labor.

Another mistake frequently made in constructing or remodeling buildings is that of having too many roofs.

We have inherited a bad practice from our ancestors of putting the cows in one barn, the horses in another and the pigs and chickens off in a couple of others. In spite of our present board of health requirements for producing market milk, the best place for the horses on a dairy farm is usually in one end of the cow stable. The horses can be separated from the cows by a tight partition and if need be, a double door can be opened in less time than it takes to go up a flight of stairs or a hundred feet away to another building.

Two farm management men gave some most excellent advice on farm buildings. Issac P. Roberts, former dean of the College of Agriculture at Cornell University said, "First know what your farm business will be like, think over your plan of building and then sleep on it a while before you build." Marius Porcius Cato, the old Roman censor who in addition to being a statesman was no mean farmer, said, "The farmer should ponder before he builds, and when you build let your buildings be proportioned to your estate." After deciding on what the system of farming is going to be like, one should have a definite long time building plan.

One of the things to be avoided in a building plan is hobbies. We have all seen round barns, square barns, octagonal barns and other similar monstrosities standing as monuments to some man's hobby. It is human nature to say; "I just wonder how it would be to build such a kind of barn."

There are five important factors to be considered in planning the construction or rearrangement of a set of farm buildings: Future needs, economy of labor, capacity, cost, and structural details. All but the last involve questions of farm management.

Future Needs. Two things which should be kept definitely in mind are possible future expansion and pos-

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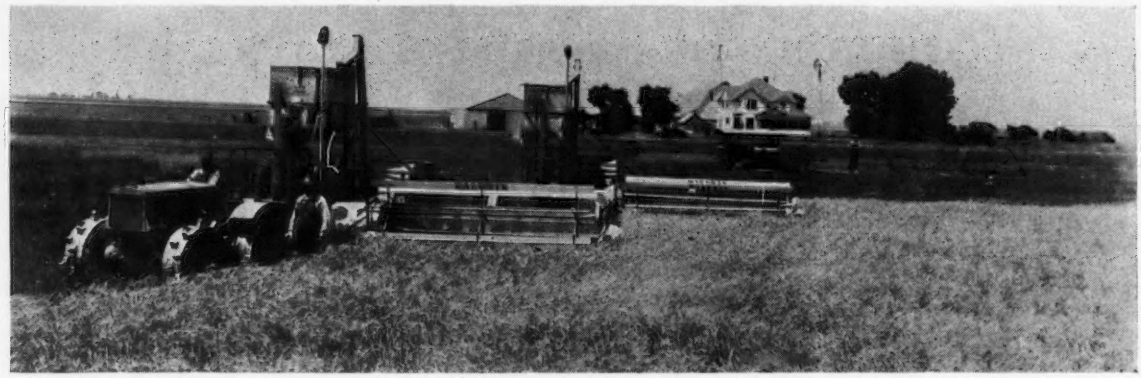
[2]Professor of agricultural economics farm management, Cornell University.



Proximity of the farm buildings to the crop fields is more important than their nearness to town or to pasture lands. Every extra half mile between a field and the barn makes the field worth $47.60 less per acre

sible changes. The man who says that his barn will hold all his place will ever raise may find that he needs to enlarge his buildings when his son gets ready to go in with him and buy some more land. Or the man who builds a sheep or machinery barn 28 feet wide may sometime wish he had built a few feet wider when he tries to put two rows of cows in it.

Economy of Labor. Whether or not a barn is economical of labor depends principally on its arrangement and on labor-saving devices. Probably the most important labor-saving and also money making device in a dairy barn is a good set of water buckets. Another important labor-saver in a dairy barn or poultry house is some means of carrying grain and ensilage. This means either a feed carrier on a track or a cart. For a poultry house a track carrier is far better than a cart as it is difficult to push the latter over the litter or through a flock of hens. In a dairy barn, and especially for handling silage, a home-made wooden box cart is usually fully as satisfactory as an expensive car and track. An ensilage cart of this kind can be made to just fit the silo chute, thus saving shoveling a large part of the ensilage from the floor into the cart.

A most important labor-saving item in any kind of a stock barn is having it arranged so that manure may be taken out with a spreader. With cows this usually means having tails together and in a hen house having large enough doors so that a spreader can be driven or backed in. Many men who would like to have their cows face in are forced into saving labor when they fix over an old narrow barn. A barn 30 feet wide is too narrow for two rows of cows headed in but can be used if cows face out. A manure spreader can be driven through most stables in which the cows face out.

Capacity. Before building, one should figure out the present and probable future number of bushels of grain, tons of hay, straw and silage to be stored in a good crop year.

Cost. From a farm management standpoint there is no set rule as to cost but as Cato said, "Let your buildings be in proportion to your farm." With present cost of building materials and skilled labor, the cheapest way to build a barn is usually to buy a farm and get the buildings thrown in. There are two economic factors back of this statement. One is that even in pre-war times, the man who spent $3000 to build and equip a barn on a farm that cost him $7000, usually could not sell his place for an additional $3000.

The second factor is our present relatively high cost of construction as compared with the price of farm products. This means that there is now on the market a large supply of farm buildings built at much below present cost. It is now more difficult than in normal times for the man who builds a barn or buys barn equipment to get his money out of his investment if he wishes to sell. At present the man who has a fire can usually buy elsewhere cheaper than he can rebuild.

Another economic factor in the present farm building situation is that we are apparently somewhere near the peak of a country wide building boom. No country has ever experienced a period of relatively cheap food and high wages without bringing on a building boom with the resulting high prices of building material and still higher wages of carpenters, masons and other construction workers. I think we can expect a generally declining price level during the next few years. Others think differently. However, history shows us that there has been but one building boom that did not break and that is the present one. Even now there are indications that we are getting "caught up" on construction in many of our smaller cities.

Notwithstanding present high costs of construction, many farmers are either forced or think they are, by fire or other reasons, to build. I am strongly of the opinion that the man who builds a barn at the present time or who invests heavily in barn equipment may expect to take in addition to normal depreciation on his investment, due to wear and tear, some extra depreciation due to a declining price level, plus some more due to the fact that a thousand dollars spent in building improvements usually does not increase the sale value of the place by that amount.

From a farm management standpoint and as concerning farm buildings the man who first said, "Save the surface and you save all," might better have said, "Save the roof and sills and you save all." There are few examples of a barn falling down from lack of paint. In investing in a crop and stock business, money should first be used to get good land, then good stock and then suitable buildings and equipment. Then if there is anything left, we might consider buying paint. In farm buildings, horizontal surfaces are painted for preservation, fronts for looks and back sides for luxury. Further improvements in methods and equipment for spraying paint would do much toward getting more of our farm buildings painted.

There are two important factors that should be kept in mind by the purchaser and seller of barn equipment, and the person who holds notes for equipment already sold. One is that present high cost of labor means that the most valuable kind of barn equipment is the kind that saves labor. The other is that barn equipment does not give milk or lay eggs. Cato's advice about letting buildings be in proportion to the farm might be extended to say, "Let your barn equipment be in proportion to your stock." The man who is keeping a herd of high-producing purebred cows and selling grade A or certified milk may be justified in having cork floors and expensive individual stalls but the man with the low producing herd who is selling milk to a cheese factory or condensery had better stick to his present equipment, put his money into a good herd bull and limit his investment in special barn equipment to water buckets and a set of milk scales.

GENERAL FARM EQUIPMENT

A hundred and fifty years ago, George Washington said that agriculture was going through a revolution due to the rapid improvement of farm equipment. The same could have been as truthfully said by any of the succeeding presidents and will probably always be a safe statement to make. The invention of every labor-saving machine makes it more difficult for the man whose conditions are not adapted for it use. Present high costs of man labor are tending more and more toward new kinds of labor saving machines and larger units of those now in use.

It is a well-known fact that depreciation is high on new types of machines due to their becoming obsolete before they are worn out. The present day farmer needs to strike a happy medium between "not being the first by whom the new is tried nor yet the last to lay the old aside." There is a decided need for our experiment stations, colleges, and manufacturers doing more experimental work with new and improved types of machines. The testing out under farm conditions of new machines that is now being done by many of our manufacturers is to be highly commended. An experiment station or a manufacturer is in much better position to stand the loss incurred by investment in an unsatisfactory machine than is the individual farmer.

While rates of depreciation vary greatly on different kinds of farm tools and on different farms, investigational work shows that the average lot of general farm equipment, exclusive of tractors, trucks and special threshing machinery, is about 10 per cent per year of the inventory value. The average farm outfit always includes some old and some new tools. If an inventory taken at farm sale value shows $1000 invested in a miscellaneous lot of farm equipment, then it can be expected that under average conditions the equipment will be worth about $900 at the end of the year.

Cost accounts kept on New York state farms show that the total annual cost, including depreciation, repairs, storage, and all other costs of maintaining a miscellaneous lot of farm equipment, will average about 40 per cent per year of the inventory value. If a man has invested $1000 at farm sale value in a miscellaneous lot of farm tools, some old and some new, it will cost him about $400 per year for ownership and maintenance. The cost of horse drawn equipment on these same farms for the last five years has been $.11 per horse-hour. These same studies and my personal observations on these farms also indicate clearly that lubrication and keeping nuts and screws tight is more important than housing in reducing equipment costs. Depreciation is due far more to machines grinding or shaking to pieces than from being housed out in the "big blue shed." This is becoming increasingly true as metal is substituted for wood in the construction of farm machinery.

One great need at the present time is the training by resident school instruction and extension meetings of our future farmers to operate and repair the machines that have come into use in recent years. Our grandfathers as boys could be taught to swing a grain cradle by their grandfathers. The grandfather and often the father of the present farm boy can't teach him much about tractors, power sprayers or combines.

Tractors. Improved models of tractors, fewer makes and better dealer service are tending to reduce the cost of tractor operation. Studies made in 1920 on New York farms showed the average cost per hour of a tractor, exclusive of cost of operator, to be $1.16. A study made six years later in 1926 showed a cost of $0.88 per hour. The average annual cost per tractor in 1926 was $268.63. Of this amount depreciation was the largest single item, being 36 per cent of the total cost. Fuel was 33 per cent of the total cost, interest 10 per cent, and lubrication 9 per cent. Repairs and mechanic's labor were 6 per cent of the total cost and farm labor, insurance and storage made up the balance.

The average tractor included in this study was used 313 hours during the year and the amount of work done by the tractor was the most important factor affecting cost per hour. Tractors used less than 200 hours cost $1.37 per hour, those used from 200 to 400 hours cost $0.86 per hour, and those used 400 to 600 hours cost $0.78. The tractors used over 600 hours cost $0.64 per hour or less than half the cost of machines used less than 200 hours. While plowing and fitting constituted the major part of work done by the average tractor, belt work amounted to 23 per cent of total work done. Custom work aids in increasing total hours of work and lowers cost per hour. Approximately one-sixth of the work done by these tractors was custom work. Over half of the tractor owners did some custom work and the average tractor worked on four different farms.

The displacement of horses and hired labor by a tractor is an important factor and varies considerably with different regions. Under New York state conditions the average tractor replaced 2 horses and 3 months of hired labor. Horses were not displaced to any great extent in the lighter and more rapid field operations such as cultivating and haying, but the effect was very marked in operations like plowing, harrowing and disking.

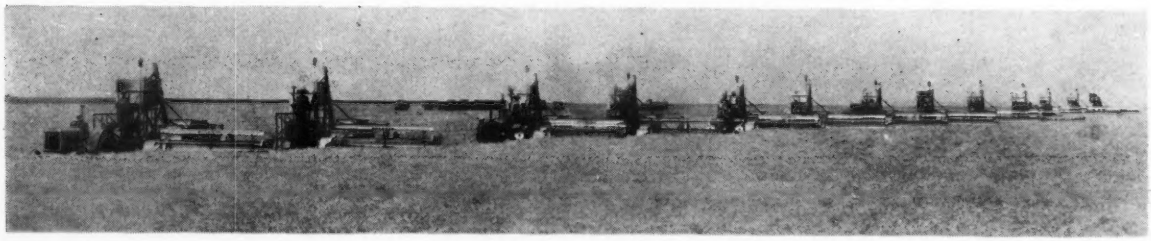
The principal disadvantages reported were difficulty of operation on poorly drained land and in small fields or those having rocks and stumps.

From a farm management standpoint, the most important conditions favoring the owning of a tractor are:

1. Large enough business to furnish over 200 hours of work per year
2. Favorable drainage and topography
3. Favorable layout
4. Opportunity for belt work.
5. Difficulty in getting planting and sowing done on time with horses

In considering the purchase of a tractor the question of whether it will pay should be first answered on the basis of the above factors. Another question is whether or not the money necessary to buy and operate a tractor would pay better if invested elsewhere in the farm business.

The most important factor involved at the present time in the economics of farm structures and farm equipment is the saving of man labor. With farm labor costing nearly double prewar and farm products selling for only about 50 per cent above prewar, I feel that the problem of the agricultural engineer, whether he be teacher, investigator, manufacturer or salesman is, "How can we help farmers make more efficient use of man labor?"



Depreciation is due far more to machines grinding or shaking to pieces than from being housed out in the "big blue shed." This is becoming increasingly true as metal is substituted for wood in the construction of farm machinery

The Individual Plant in Rural Electric Development[1]

By J. E. Waggoner[2]

WHAT is the true economic value of the individual electric plant? It is used by about 450,000 farm families. These are families who in the main would not otherwise have known the blessings of electricity. If it were possible to place a cash-and-carry price on the value of the individual plants as measured by the lives of farm folks, we all agree it would be high. The nearest we can approach this is to figure the value of the time saved by transferring tasks from the shoulders of the farm women and men to a plant.

The following information was obtained from a wide experience embracing farmers all over the United States. The answers are in the main almost too conservative, but nevertheless the saving of time by the use of an individual plant is very remarkable.

Value of Electric Service to the Average Farm Family

Hours Saved per Week			
Lamps	1½		
Washing	2		
Ironing	2		
Cleaning	1½		
Separator	1		
Water	7		
Chores	4		
Total	19	at 25 cents =	$4.75 per week
		=	$247.00 per year

Dividends in Service	
Comfort, convenience, contentment	$ .70 per week
Protection — fire	.35 per week
Protection — burglary	.20 per week
Radio	.10 per week
Health	1.00 per week
	$2.30 per week
	or $110.60 per year
Other Dividends	
Egg production	$150.00 per year
Saving pigs	25.00 per year
Saving fuel and operating power	25.00 per year
	$566.60 per year
Operating expense, depreciation, interest, etc.	$110.00
Net value	$536.60

C. E. Seitz, agricultural engineer, Virginia Polytechnic Institute, has done some research work along this line. Here are the figures he has supplied:

Washing Machine Data

Hours saved in doing a wash	209.16 per year
Cost of labor (hired help) saved	$36.40 per year
Value of time saved at 25 cents an hour	$52.29 per year
Total saving per year	$88.69

Ironing Data

Time saved	211.6 hours per year
Cost of hired labor saved	$45.12 per year
Value of time saved at 25 cents per hour	$54.15 per year
Total saving per year	$99.27

Churning Data

Time saved	$55.26 hours per year
Cost of labor saved	14.40 per year
Value of time at 25 cents per hour	13.80 per year
Total saving per year	$28.20

Housecleaning Data

Figuring time and labor saved at 25 cents an hour, there is a saving of 24 cents per room per cleaning. Assuming that the room is cleaned three times per week, there is a total saving of $37.44 per year.

A study of the above figures shows that the savings in washing, ironing, churning and housecleaning amount to $253.60 a year. This is exclusive of the savings brought to other everyday tasks, and does not take into account the vastly increased comfort and convenience electricity brings.

From a recent report of the National Electric Light Association there probably is not a very great difference between the number of farmers served by central stations and those served by individual plants. The report shows 454,100 farms as of January 1, 1929, receiving service from central stations. On the other hand, about 600,000 individual plants have been sold. Allowing 150,000 to 200,000 plants for replacements, worn-out units, etc., there still will remain from 400,000 to 450,000 individual plants giving service to farmers in the United States. It is perfectly safe for us to say that well over one-half million farm home have had their first experience with electricity from individual plants. In other words, the individual plant was the first to take to them the blessings of electricity.

The individual plant and the central station service work together splendidly. Individual plants pave the way for central station service. The farm families that have had plants know the advantages of electricity. They are the easiest to sell on the idea of a power line; from my personal experience in Texas, I know they are the most anxious to obtain high-line service. They are the best users of electricity, and I have been told they are the easiest satisfied. Many rural service managers have told me that they do not know of a farmer who previously had an individual plant complaining about rates or bills. These farmers realize that, to have the advantages of electricity, someone must pay the bills, and electric service at any reasonable cost is well worth having.

When we think of the farm field and the use of electricity in that field, the first question that naturally comes to mind is, "What percentage of all farms now have electric service of some kind?" In other words, what part of the farms in America have been served? From the figures given earlier in this paper, the total, let us say, is about 900,000 that have either individual plants or central station service. I think that is a very liberal figure. Then there remain 5,400,000 farmers who sit in electrical darkness. We have heard a great deal about this startling number who are without the blessings of electricity.

Last year our company started a comprehensive investigation of the possible field for the individual electric plant. We turned the searchlight on those 5,400,000 farmers scattered over the United States and sorted out the poor farmers, tenants, etc., who are not logical prospects. There remained 2,009,500 farmers who are able financially to have service. In other words, their economic status puts them in the class of users of electricity.

To localize these figures, we found that there are 592,000 farm homes in the states represented by the North Atlantic Section of the American Society of Agricultural Engineers. After subtracting 120,000 users, there are 473,000 farmers in this section without electric service of any kind. Of these 220,000 in this section are able financialily to have and enjoy electric service. This is

[1]Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers at Amherst, Mass., October, 1929.

[2]Manager, public relations division, Delco-Light Co. Mem. A.S.A.E.

Phantom view of farm buildings lighted by an individual plant

a tremendous field, and it is in reality a duty that we work together to supply these farm families with electricity of some kind.

We were not satisfied with just the information as to the number of farms that did not have service, but we wanted to know how and where these farms were located with respect to the road systems. On further investigation we found that 1,419,000 farms of the United States are located on hard-surfaced roads; 1,998,000 farms are located on improved dirt roads; and there are 2,747,700 farms on unimproved dirt roads. It is reasonably safe to say that the hard-surfaced roads in general join the cities and small towns of the country. In other words, they are the direct routes of travel and therefore most likely to have central station service. The improved dirt roads might be considered as closely adjacent to to the hard-surfaced roads and power lines. It is those on the unimproved dirt roads which will be the slowest and the last to obtain service from central stations.

This isn't all of the story, because along with this vast number of farmers living on dirt roads, there is another problem caused by the intermingling of rented and inefficiently operated farms along paved roads, which will make it not only difficult but unprofitable to build rural lines. The better class of farmers in this territory not open to power line development offer a great market for individual plants. It is the only source of electric current available for them.

Most farmers want electricity but are often puzzled as to how to get it. This condition is brought about in part by lack of cooperation, sympathy or understanding by all the organizations interested in extending electric service to the farmer. Some of these organizations it seems have dropped the individual plant from the plan.

Many leaders of this great movement now feel that, when we talk about rural electrification, we should include the individual plant. We have seen that the individual plant is now supplying electricity to about one-half of the farms that are fortunate enough to have this service. And it is very evident that the individual plant will be the only source of electric service available to many hundred thousands of farms during this generation. I might say, as a matter of explanation, that these leaders to whom I refer are not connected with the individual plant business. The represent the utilities, the press, the colleges, etc. Isn't the individual plant serving an important enough place in our scheme of rural electrification to warrant greater consideration in the hands of all organizations working to take electric service to the farm?

I find that many people think of individual plants in terms of those available from 1917 to 1920. There have been many forward strides since that time

The first individual plants were battery-charging plants. In other words, the battery was charged at frequent intervals and all the load was taken from the battery. The next step was a full automatic plant which was so made as to require only a small starting battery. When any load was turned on, the plant started automatically. While this type of plant did not require much of a battery investment, yet the operating cost was unusually high, due to the fact that it usually operated on small loads.

About three years ago engineers conceived and developed the now popular combination type. By way of explanation, with the combination type loads up to 250 watts are taken from the battery. When a load larger than this comes on the line, the plant starts automatically and runs as long as such a load is on the line. If the load is not sufficient to take the full capacity of the generator, a trickle charge goes into the battery. This helps to keep it in proper condition. If the plant should run out of fuel when the housewife is ironing, and she does not notice that it had stopped running, the current will come from the battery until the voltage has dropped to 22 volts. Than a relay will operate and the current will stop flowing, and consequently the housewife will begin to investigate. If, on the other hand, the plant does not start when a heavy load is put on the line, the battery will crank the plant for about a minute and a half, then a cranking cutout will operate and thus protect the battery. In other words, the combination plant is made as nearly foolproof as possible.

I have often been asked, "What will an individual plant do for the individual farmer?" I have investigated this and find that the individual plant will do a large percentage of the tasks now done by central station service on the average farm. Do not take this as inferring that, if a farmer is situated where he can get central station service, he should still buy an individual plant. I am making this statement simply to show that the man who is now far off the high-line can have an electric service which is comparable to the service his neighbors may have from central stations. Modern plants will not only supply lights for the house, barnyard, poultry house, etc., but in addition will furnish power for a washer, vacuum cleaner, churn, refrigerator, water system, cream separator, milker, grindstone, incubator and well over a hundred other applications of various kinds.

In my investigation I found that on some of the experimental electric lines the energy consumed by large-wattage equipment, such as ranges, water heaters, 5-hp. motors, etc., was a small percentage of the total current used. For instance, in the Marysville, Ohio, experimental line report for 1928, the above equipment was responsible

for only a small percentage of the total energy consumed. In other words, an 800-watt plant could have supplied 84.2 per cent of all the electrical energy used on any one of these farms and not have been overloaded.

CONCLUSION

1. There is a spirit of cooperation between the power companies and the individual plant manufacturers. Real progress has been made in this movement during the past year.

2. The individual plant paves the way for central station service.

3. The individual plant has given to well over one-half million farm families their first experience with the blessings of electricity.

4. Electric service is contributing materially to the welfare of the farm family.

5. The individual power and light plant is of decided economic value to the farm family.

6. There are still about 85 per cent of the farm homes without electricity.

7. The individual plant is the only source of electric service that can at the present time economically reach a large percentage of these farms.

8. The combination plant will now do a large part of the work ordinarily done on the average farm by electricity.

Automobile Operation Cost

IN A recent bulletin which pointed out the savings made to the individual owner of automobiles through the existence and use of good roads, the American Road Builders Association published the following facts:

"The average relative gasoline consumption, determined from reported engine tests and actual measurements on the road, showed that where a vehicle will travel 15 miles to the gallon on a high type surface, it will require 1.2 gallons on the intermediate type and 1.47 gallons on the low type road surface for the same distance.

"From detailed cost records reported on about 800 automobiles operated in various parts of the United States, figures were prepared taking all factors into consideration, showing the average cost of automobile operation over all types of surfacing to be in cents per mile: Light fours, 6.02; medium fours, 6.42, heavy fours, 7.20; light sixes, 7.38; medium sixes, 8.40; heavy sixes, 9.45.

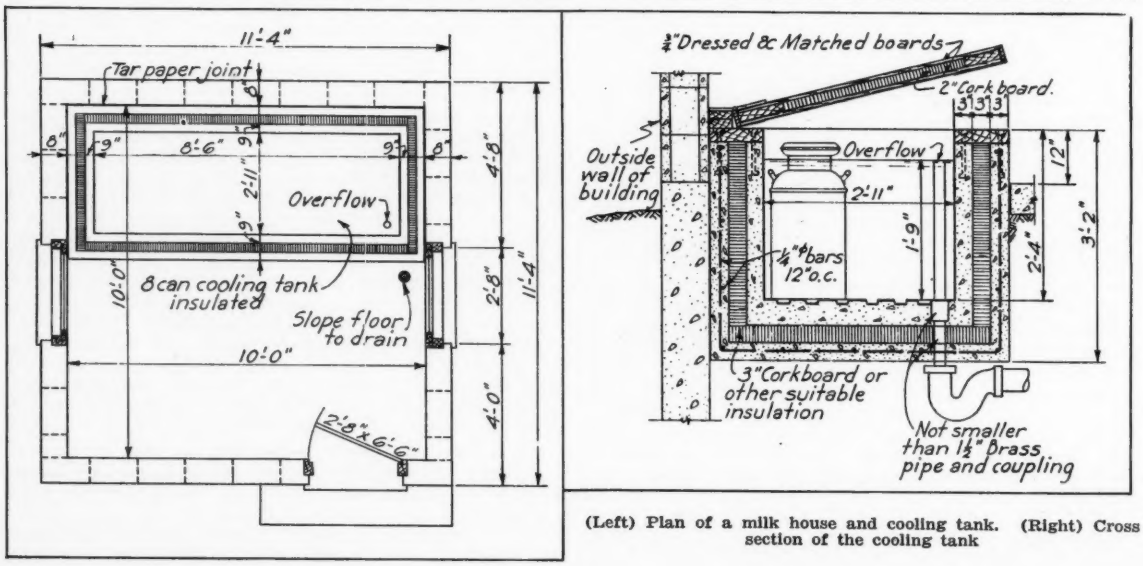
"Among the various items of operating cost, road condition is shown to have no effect on license, garage, interest and insurance. The increase in cost of maintenance and in depreciation of automobiles as the type of road becomes poorer is in somewhat the same ratio as the increase in gasoline consumption, shown above. In cost of tires and tubes comes the greatest increase, and it is estimated that where $1 is expended for this item on high type roads, the cost is more than double on intermediate type roads, or $2.22, and almost triple on low type roads, or $2.90.

"The division of cost items on an imaginary "average" automobile based on annual mileage of 11,000, is shown as follows:

Item of Cost	Cents per Mile
Gasoline	1.31
Oil	0.22
Tires and tubes	0.64
Maintenance	1.72
Depreciation	1.39
License	0.24
Garage at $4 per month	0.44
Interest at 6 per cent	0.36
Insurance (fire, theft, tornado)	0.21
Total cents per mile	6.43

"The saving shown in operation of such average automobile due to road improvement is, where low type roads are changed to intermediate type, 1.07 cents per mile, where intermediate type is changed to high type, 0.99 cents per mile, and where low type is changed to high type, 2.06 cents per mile.

"The cost tables range from eleven cents per mile, the cost of operation of a "heavy six" over low type roads, down to 5.10 cents, the cost of operating a "light four" over high type roads. This gives a conservative figure for the lightest car and the best road conditions obtainable, and for the heaviest car operating on low type roads."



(Left) Plan of a milk house and cooling tank. (Right) Cross section of the cooling tank

Filling Silos With a 3-hp. Motor

By John M. Larson[1]

FILLING silos with 3-hp. motors may sound like "the idle dream of a dreamer who dreamt that he dreamed." Impossible as it may seem yet it has been accomplished.

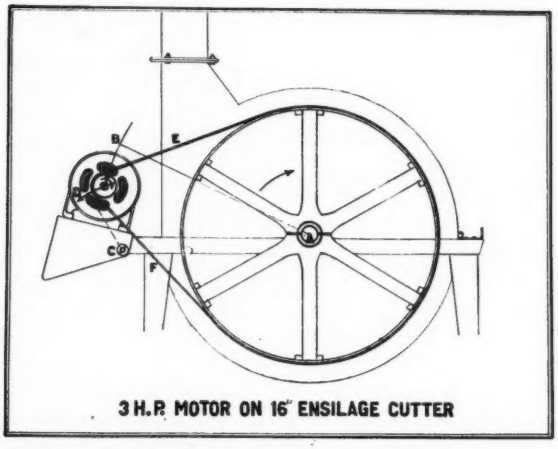
Ordinarily when using a motor the belt has to be drawn very tight in order to keep it from slipping. When a small motor with a small pulley is used, the tension is so great that it often causes bearing trouble. In order to get away from this trouble, the Papec Machine Company has devised a scheme whereby the motor can be mounted on the machine and thus reduce belt windage to a minimum and also make a compact machine that is ready to start when the cutter is set in place. The accompanying photograph and diagram show how this is done.

At first sight one would think that it would be impossible to avoid belt slippage with such a small arc of contact on the motor pulley. Ordinarily it would require a very tight belt, but since this is a 3600 r.p.m. motor the peripheral speed of the pulley is so great that much less pressure per square inch is needed to transmit the needed power.

A study of the mechanics of this set-up will show what happens. From the diagram it can be seen that, if the cutter pulley was fixed and could not turn and the motor free to move and if the belt was drawn tight, the motor would move in a circle about the point A as shown by the arc B when the power was thrown on. But since the motor is fastened at point C and free to revolve about this point, the center of the force being to the left of point C makes it necessary for the motor to shift to the left and thus create tension in the belt, E F. Due to a resistance set up by the cutter pulley, this shifting of the motor takes place. The greater this resistance is, the greater is the tendency to shift. Thus, as the load of the cutter increases, the tighter the belt will be. As soon as the load eases up, the tension in the belt is reduced. By this simple method it is possible to have a tight belt when the pull is hard and a loose belt when there is a light load. This makes it much easier on the motor bearing.

The photograph shows a Papec machine equipped in this manner.

[1]Division of agricultural engineering, University of Minnesota.



This diagram shows the position of the motor as it was mounted on the ensilage cutter in the Minnesota tests

One of these machines was used to cut ensilage with and elevate it into a 36-foot silo. The cutter pulley was 40 inches in diameter and the motor pulley was 4 inches in diameter. A 4½-inch endless leather belt was used. The motor was a 3600 r.p.m. General Electric motor of the S.C.R. type.

The cutter ran at an average speed of 380 r.p.m. idle, and 365 r.p.m. when loaded. This shows that there was very little slippage, if any, due to the load. The motor's actual speed was 3800 r.p.m.

It was late in the season before this equipment was available, and the only corn that could be had for use in these tests was some that had been cut and in the shock for about three weeks. As a first trial the cutter was equipped with three knives and such gears as to make it cut ½-inch lengths. A quantity, 770 pounds, of this dried out corn was put through the cutter which gave the following results:

Rates in tons per hour	6.15
Average power input (kilowatts) to motor	4.33
Kilowatt-hours required per ton	0.72

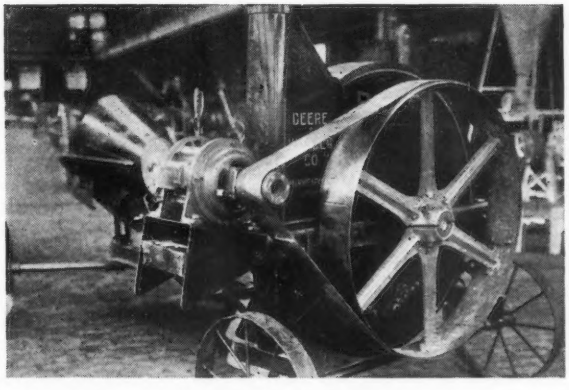
This compares very closely with that accomplished with a 5-hp. motor on the same cutter, cutting only about one ton less per hour and the energy per ton being somewhat less.

A second set of tests were made with the same cutter and motor using only two knives. With this arrangement three loads were cut. These loads weighed on an average of about 1600 pounds each. The following is a summary of the data secured with this arrangement:

Rate in tons per hour	4.36
Power input (kilowatts) to motor	4.18
Kilowatt-hours per ton	0.908

It can be seen that in this case the rate in tons per hour was reduced because the motor handled the load best when the bundles were lapped about one-third. Naturally the feeder ran slower as there were only two knives on the cutter and it was making the same length of cut. The cause for the increased energy consumption was, of course, due to the fact that the overhead load of the cutter was required for greater length of time to cut the same amount of ensilage.

The accompanying wattmeter record shows what happened while unloading one of the loads in the second set-up. This load weighed 1780 pounds. The average power input was 4.21 kilowatts. This is overloading the



This picture shows a 3-hp. electric motor mounted on a 16-inch ensilage cutter. This compact outfit is the one used in the Minnesota tests

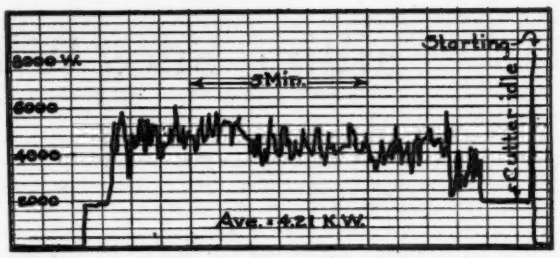
motor to a considerable extent, but it did the job without any hesitancy at all as can be seen from the graph.

The cutter idle required 1.95 kilowatts input which is nearly one-half of the total load. The actual energy used in this case for cutting and elevating a ton was 0.45 kilowatt-hours, and the energy used to overcome the overhead of the cutter while cutting one ton was 0.37 kilowatt-hours. This shows how little energy is really needed to do the cutting and elevating. The real slow rate of cutting, however, is not the most economical as far as kilowatt-hours per ton is concerned.

The graph shows how uniform the power requirement really can be when uniform, careful feeding is done, which is a big factor in operating ensilage cutters with small motors.

While it would not be good practice to advise the average farmer to use this method of ensilage cutting, it did bring out two outstanding points:

1. That a large power unit is not necessary for silo filling since as small a motor as one of only 3-hp. can handle the job at a fairly good rate.



Graph showing watt meter record taken while ensiling a load of dry corn in the Minnesota tests

2. It has also shown how a motor can be mounted on a cutter so as to make a convenient, compact unit out of it and maintain a tight belt only when a tight belt is needed, and a slack one when the load is light, thus saving the motor bearing.

Substitutes and Competition

By F. A. Lyman[1]

DISCOVERY of substitutes for common necessities of our everyday lives and for economic elements upon which our present highly developed civilization and financial structure are based have been announced with clocklike regularity by the daily press of the nation during the past year. Two of these are of especial interest to American agriculture. One deals with a German scientist who is reported to have perfected a process now being exploited commercially for converting wood wastes into animal feed. From England we hear of a new cotton substitute in the form of a fibrous plant which can be grown at "barely more than half the present cost of raw cotton." In the former case it is reported that wood waste is transformed into a carbohydrate substitute for corn and other grains at a cost considerably below the price charged for feed grains.

What will be the effect on the agriculture of the United States in case the cotton and grain growers of this country have to meet the competition of cheap substitutes, both abroad and at home? It is well, of course, to take such reports of revolutionary discoveries with at least the proverbial grain of salt, but it is within the realm of possibility that they are commercially practicable. It is probable, too, that the cotton substitute could be grown in the United States as well as in England, thus offering a means for meeting the new competition.

No one can foretell the results of such discoveries as they affect the industries and the people of the nation. The rise of the rayon industry, for instance, was at first observed with alarm by the silk and other textile industries. But despite an increase of ten times in eight years in the amount of rayon produced, this thriving industry is now regarded as an ally and accelerator, rather than a competitor, of other textiles. For one thing, it utilizes comparatively large amounts of cotton in its manufacture.

On the other hand, the development of the automobile has sounded the death knell of the buggy, and the age-old lumber industry is finding it necessary to aid itself in resisting the onslaught of other building and construction materials. Animal power is annually losing ground to mechanical power, and electricity is making inroads on the former strongholds of other forms of power. The meat industry is competing against the vegetable and fruit growers for the favor of the consumer. The eastern cotton belt, in spite of cheap labor, is fighting to hold its own against still cheaper machine production methods on level western lands.

Thus we have product competing with product, territory against territory, and, what is more important from the standpoint of the country's welfare, nation against nation.

It is regarded as rank heresy to even hint that the farmers of the United States are not the most efficient producers of agricultural products in the world. Yet a study of the export statistics relating to farm machinery reveal, for instance, that until 1925 more combines were purchased by wheat growers of other countries than by farmers of the United States. A fourth of our tractors are exported annually. Canada and the Argentine are leaders in adopting labor-saving machinery to lower the cost of producing corn and wheat, and, combined with cheap land, they are producing these products at lower cost than we here in the United States. New Zealand dairymen are leaders in the economical production of dairy products. In other words, farmers in other countries have taken lessons from American agriculture and in some cases are beating us at our own game. This means increased competition in the markets both at home and abroad.

One-horse cultivators are still used in the United States, and in no small numbers. So are walking plows—and in territories where larger plows and cultivators could well be used. Uneconomic crop and soil management is still being practiced by many. With our high standard of living and our high wages, we are even now finding it difficult to compete with some of our competitors in other countries.

Taking the days news regarding the new cotton substitute which can be produced at half the present price of raw cotton as a case in point, there is consolation—if consolation is needed—in the fact that it is in the power of our cotton growers to meet such competition on an even footing. Cotton is even now being produced in Texas at a third to a half of the cost of cotton raised by conventional methods in the old cotton belt. But in this or other cases, we cannot afford to rest on our laurels, for amazing progress in the production of staple crops is being made by foreign competitors. We will have to continue to match their progress, step by step, if we are to maintain the advantages of the most efficient agriculture in the world.

[1]Managing director, Farm Fence Institute. Assoc. Mem. A.S.A.E.

Committee Makes Recommendation on Corn Borer Control

THE European corn borer has continued its natural spread since its discovery in America in 1917. Its average rate of advance to the south and west has been from 24 to 30 miles per year. In 1929 it occupied 10,000 to 12,000 square miles of new territory in the United States. It now occurs throughout the southern portion of Quebec and Ontario, as well as locally in New Brunswick and Nova Scotia in Canada, the southern two-thirds of New England, the northern extremity of New Jersey, all of New York, three-fourths of Pennsylvania and Ohio, the panhandle of West Virginia, nearly all of the agricultural portion of Michigan and the northeastern fourth of Indiana. It has now reached the threshold of the main Corn Belt.

The corn borer is only thinly distributed over the newly infested territory and causes no apparent injury. It increases in numbers rather slowly at first and, judging from past experience, will not cause evident injury in the first 2 to 4 years. This provides a period during which the entire community should obtain and apply the latest recommended control measures. In most of the older infested areas the borer has increased greatly in numbers. Where this insect has been established for several years, commercial damage to corn now occurs unless natural factors have checked the borer temporarily or adequate control measures have been applied. If this is true in the eastern edge of the Corn Belt, where most of the corn is cut and much of it put in the silo, thus simplifying an adequate clean-up, how much more will it be true in the main Corn Belt where most of the stalks are left in the field?

It, therefore, is still the opinion of the Joint Committee on the European Corn Borer that, unless the corn borer is controlled, it will become one of the most destructive crop pests ever introduced into America. The situation, presenting as it does, the possibility of enormous agricultural losses, calls for the continued cooperation of the farmer, the scientists, the educator, and all state and federal administrative officials.

The cooperative committee on entomologists, agronomists, agricultural engineers, agricultural economists, and animal husbandmen, most heartily endorses all endeavors to control the corn borer, and commends the efforts of all farmers practicing control measures and all persons engaged in the research, regulatory, and educational activities.

The committee recognizes the necessity for the continued development of the research, educational, and quarantine programs of the state and federal governments and earnestly recommends the appropriation of the funds necessary to maintain these activities, and expand them when necessary.

After careful and complete investigation of the corn-borer regulatory, research, and educational activities, the committee suggests and recommends:

1. That since the quarantine efforts have been successful in preventing long-distance spread by artifical means, and since the only known spread of any importance in the United States has been by the natural flight of the corn-borer moths or by water drift of infested material, the quarantine activities of the federal governments of the United States and Canada should be supported and encouraged by the states and provincial agricultural colleges and experiment stations, the state departments of agriculture, and all other agencies interested in the welfare of American agriculture.

2. That because the clean-up in certain of the infested areas has not been complete and the borer population is increasing, quarantine action is much more imperative.

3. That scouting should be continued in the areas contiguous to know infested areas and extended to the larger corn-producing states where areas seem particularly exposed to infestation. Ample funds should be available for thorough clean-up of isolated infestation in such areas.

4. That two primary methods of control of the corn borer are recognized, namely, (a) the utilization or destruction of all host plant remnants each year, and (b) the somewhat later planting of corn. To facilitate the first of these methods labor-saving tools and farm machinery should be devised or improved as rapidly as possible.

5. That gratifying progress in European corn borer research has been made during the past year. Certain phases have yielded results from which conclusions of both practical and technical value have been drawn. On the other hand, the committee wishes to emphasize the necessity for continued effort in each of the major lines of entomology, agronomy, agricultural engineering, agricultural economics and animal husbandry. While certain lines of work have served their purpose and should be discontinued along with those that have been found unfruitful, there are still many problems requiring continued study as well as others yet unattacked, and it is urged that future emphasis be given these. In addition, the committee suggests that all major phases be expanded so far as practicable, into corn-belt states not yet infested with the borer.

EDITOR'S NOTE: The foregoing report is signed by the official representatives of the following organizations which constitute the membership of the Joint Committee on the European Corn Borer: American Association of Economic Entomologists, American Society of Agronomy, American Society of Agricultural Engineers, American Farm Economic Association, and American Society of Animal Praduction.

*Report of the Joint Committee on the European Corn Borer presented at Toledo, Ohio, September 27, 1929.

Fertilizer-Distributing Machines Adjustment to Varying Conditions

THE distribution of fertilizer by machine is subject to considerable variation under the changing conditions that normally occur in the field, according to the Division of Agricultural Engineering, Bureau of Public Roads, of the United States Department of Agriculture.

A recent study showed certain distributors to be so constructed that a free-flowing fertilizer will flow by gravity through the distributing mechanism when not in motion, which is not only objectionable but may result in the wasting of considerable fertilizer. Some distributors have a means of covering the discharge opening when the mechanism is idle.

When a distributor has more than one distributing unit as, for instance, a grain drill attachment, the engineers say, it should not be assumed that like amounts of fertilizer are being discharged from each unit. It was found in extreme cases that more than twice as much fertilizer was discharged by some units as by others although the machine as a whole was delivering the desired amount of fertilizer. The greatest differences will likely occur at the lower delivery rates and the trouble will usually be found in the position or adjustment of the fertilizer gates.

Inclining the distributor from its normal operating position, as is the case in traveling over sloping round, was found to affect the delivery rate in most of the machines tested. Sometimes the covering shovels on the single row knocker type of distributor, if permitted to run deep, cause the machine to incline rearward, which more than doubles the delivery rate. Lowering the fertilizer in the hopper during operation decreases the delivery rate, particularly with a free-flowing fertilizer. The delivery rate is most affected when the hopper is nearly empty. For that reason the hopper should not be completely emptied before refilling.

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture. Requests for copies of publications abstracted should be addressed direct to the publisher.

Report on Tests of the Relative Strength of Green-Cut and Fire-Killed Western Cedar Pole Timber, T. A. McElhanney and R. S. Perry (Canada Department of Interior (Ottawa), Forest Service Circular 22 [1928], pp. 15, fig. 1).—The results of tests on western cedar poles, both green-cut and fire-killed, and on small clear test specimens cut from them after breaking are reported.

Soaking the butt brought the fracture to the load (ground) line in nearly every test, closely simulating service conditions. The number, extent, and location of defects has a noticeable effect on the strength of the pole as a unit.

The small clear static-bending tests showed that the high values obtained in the pole tests are due to the inherent strength of the wood and indicate the effect of defects in the pole. All small tests show a higher specific gravity than tests from mature western cedar. They confirm the opinion that higher strength values are obtained from pole-size trees than from mature trees of this species.

The tests also showed that the strength of fire-killed poles is not materially lower than that of green-cut poles, that there is no difference in the strength of the wood from green and from fire-killed poles, and that the fire-killed pole, as a unit, is of practically the same strength as the green.

Tests on the hardness of the sapwood of all poles showed no variation in sapwood hardness for poles, whether green-cut or fire-killed, and the variation in moisture content of the sapwood was very small.

Fire-Protective Construction on the Farm (U. S. Department of Agriculture, Farmers' Bulletin 1590 (1929), pp. 11+22, figs. 13).—This bulletin presents practical information on the construction of fire resistant farm buildings, which is based on the original findings of the farm fire protection committee of the National Fire Protection Association.

Attention is drawn especially to the fire hazards generally found in farm building construction, and suggestions are made as to how they may be avoided in new buildings or remedied in existing structures.

[Agricultural Engineering Investigations at the Iowa Station] (Iowa Station (Ames) Report 1928, pp. 10-13).—Tests of a newly developed tillage machine, in which the moldboard of a standard plow is replaced by a revolving pulverizer head having blades which engage the furrow slice, beat and mix the soil, showed that the reduction of drawbar horsepower under that required for a plow is sufficient to furnish a large part of the power needed to drive the pulverizer.

Experiments with a masonry arch barn showed that under favorable conditions the cost would be from 25 to 50 per cent more than that of wooden construction. Experiments on waterproofing the roof showed that treatment with raw linseed oil gives promise of being entirely satisfactory and very economical.

In ice house experiments it was found that the ice house with the ice above the refrigeration had much to commend it on account of the small amount of labor required. With this type of ice house, which is admittedly only suited to special locations, the entire ice storage is built over a permanent refrigerator, often connected directly to the basement of the house. The ice over the refrigerator keeps it cool, while the labor of icing is eliminated and unusual efficiency in the consumption of ice is obtained. The labor of handling the stored materials is, however, increased.

In tests of dairy barn floors the concrete and rubber block floors showed much the least wear. The wood block did not show much wear, but was not particularly sanitary.

The study of the air requirements of poultry showed that air purity is in itself of secondary importance. Temperature extremes and particularly rapid temperature fluctuations have an almost immediate effect in reduced production. Excessive relative humidity while not desirable does not produce detrimental results when the temperature is moderate and fairly constant.

Some data are also briefly presented on harvesting of corn stover for industrial purposes and on corn production.

[Engineering Investigations at the Colorado Station] (Colorado Station (Fort Collins) Report 1928, pp. 44-47).—Experiments on the capping of concrete test cylinders, by E. B. House, showed that the strength of concrete cylinders varies as much as 30 per cent when capped with different materials. The Lummite cement cap gives approximately the same strength as the standard cap. It gives a slightly higher strength on the low-strength cylinders and a lower strength on the high-strength cylinders. The plaster of Paris cap, which is often used, gives a strength 30 per cent lower than the standard cap.

Tests of commercial insulating material for buildings, by C. A. Logan, indicated "the economy of insulation for the dwelling house, the main problem being that of selecting the insulating material best suited for the individual conditions. Many of the various materials have about the same insulating value but vary in their original cost, cost of application, structural strength, and appearance. It is also quite evident that a much greater efficiency is obtained by using 2½-inch thicknesses separated by an air space in place of a 1-inch thickness of the material."

Winter Construction Methods, C. S. Hill (New York and London: McGraw-Hill Book Co., 1928, pp. XI+180, figs. 77).—This book deals with processes and plant employed in prosecuting construction operations in cold weather

It contains chapters on economics and cost of winter construction; winter efficiency and servicing of labor; water supply, fire protection and camp heating; construction elements affecting winter work; transporting and storing materials in winter; winter care and servicing of equipment; winter excavation and embankment construction; ice service and hazard in winter work; concrete pavement and road-bridge construction in winter; special concretes and cements for winter work; winter heating of concrete materials and mix, handling and placing concrete in winter; protecting concrete in heavy sections; progressive canvas housing for building construction; winter building using complete enclosure; supplementary services in winter construction; and specifications for winter construction.

Fluid Meters: Their Theory and Application, Part I R.J.S. Pigott Et Al (New York: American Society of Mechanical Engineers, 1927, pt. 1, 2, ed., rev., pp. 92, figs. 37).—This is the second revised edition of this report, which is intended as a reference book on fluid meters of all kinds. It contains practical information for users of meters and general information relating to the physical principles of design and operation. Chapters are included on classification of fluid meters, weighing meters, volumeters, current or kinematic meters, head or dynamic meters, area or geometric meters, head-area meters, force meters, and thermal meters.

A summary of the important formulas involved and a discussion of the theory of head meters, together with data on nomenclature and a bibliography, are included in four appendixes.

[Agricultural Engineering Investigations at the Indiana Station] (Indiana Station (Lafayette), Report 1928, pp. 25-28, figs. 3).—In tests of the use of electricity in agriculture, feed grinders designed especially for motor drive were found to be practical for grinding small grain and ear corn in limited quantities, saving time and giving a cost, with electricity at 7 cents per kilowatt-hour, much less than the custom charge for grinding. Records on an electric refrigerator showed 2,476 kilowatt-hours used to cool and store 242 quarts of milk and cream daily at a temperature of approximately 34 degrees (Fahrenheit). Tests on silage cutters revealed the probability of successful electrical operation with speeds as low as 400 r.p.m.

In an electrically operated seed corn germinator heated by two 500-watt space heaters, three kilowatt-hours were used to test each 100 ears of corn. Tests with electric brooders equipped with 500-watt, 1,000-watt, and 1,500-watt heating elements, showed that the 500-watt brooder had very little or no reserve heating capacity for conditions which prevailed in February and March. Observations on electric water heaters for poultry indicated that heaters with a range of heating capacity are more economical than those with only one heat.

In combining tests harvesting losses with the combine were found to average less than 10 per cent, as compared to from 15 to 45 per cent with other methods.

On the experimental terraced field at Paoli no visible erosion took place in the flow lines of the Mangum terraces having a grade of 0.6 per cent or less. Where the clover and timothy sod was light there was slight erosion in the flow line having a 0.7 per cent gradient, but none where the sod was heavy.

A study of the effect of artificial heat and insulation upon temperature, relative humidity, and air movements in poultry houses revealed that when the temperature was maintained above 40 degrees the relative humidity was 10 to 20 per cent lower than when no artifical heat or insulation was used. The litter remained drier and the birds appeared to be more comfortable, but the condition was not reflected in an increased egg production.

In the grain and hay drying tests soft, moist corn which was spoiling in the crib was dried out and made fit for permanent storage at a cost for fuel of 3 cents per bushel. Alfalfa hay, which had been lying in the windrow for two weeks, was reclaimed by artificial drying at a cost of $1.35 per ton for fuel.

The Continuous Can Washer for Dairy Plants, A. W. Farrall (California Station (Berkeley) Bulletin 466 (1929), pp. 31, figs. 16).—The results of an investigation are reported which indicate that there is room for improvement in the care and operation of the average can washer in the plant. The proper cycle for can washing appears to be draining, rinsing, washing, steaming and drying. Efficiency in washing is maintained by keeping all jets and tanks clean and all solutions at the proper temperature. The can temperature follows the temperature of the jet very closely.

Wet or saturated steam is satisfactory for heating cans and giving them the first steam treatment. Dry and preferably superheated steam should follow the wet steam treatment. The attachment of a superheater may improve the drying powers of a can washer. High-pressure steam is desirable for can washers in order to obtain high temperatures. The temperature is practically the same in all parts of the can when it is steamed over a high-pressure jet.

Drying of cans requires high-temperature air taken from a dry source. Smooth cans are easily dried and rendered sterile, whereas those containing rough seams are not. There is a real need for a good seamless can. The can lids are difficult to dry and wash; a dome type lid showed good results from the drying standpoint. Moisture is often splashed into dry cans by jets not properly separated from the drying compartment. Hot cans will dry out very well if they are allowed to stand uncovered for a few minutes in an inverted position.

The power consumed by washers operated entirely by steam was from 43 to 72 horsepower at capacities ranging from 360 to 600 cans per hour. The steam consumed per can by the steam-operated washers ranged from 4.58 to 5.59 pounds. The steam consumed per can by the combination steam and electric washer ranged from 1.84 to 3.64 pounds. The electricity consumed by the washers varied from 0.84 to 2.36 kilowatt-hours per hundred cans for those with motor-driven pumps; others required from 0.045 to 0.271 kilowatt-hour. The water requirements varied from 0.85 to 4.07 gallons per can washed. The power used per can is greatly increased by operating at partial capacity.

[Agricultural Engineering Investigations at the California Experiment Station] (California Station (Berkeley) Report 1928, pp. 48-52).—In studies of the heating of milk cans over steam jets A W. Farrall found that wet or saturated steam is best for the first steaming, but that this should be followed by a second heating with superheated steam for satisfactory results in a can washer. The superheated steam left less moisture to be removed than did wet or saturated steam.

In a study of solar water heaters Farrall reported that data taken in northern California on a bright, sunshiny April day between the hours of 8 a.m. and 5 p.m. showed an average absorption of 2.23 B.t.u. per minute per square foot of exposed area by a single glass-covered stationary absorber. The studies showed that the efficiency of this type of absorber could be increased approximately 15 per cent by imbedding the coil in cement plaster having a black painted surface exposed to the sunlight.

Studies by Farrall with a large size, steam-type, electrically heated dairy sterilizer showed that good bacterial reduction was possible and that the heating was sufficiently rapid for practical purposes. The sterilizer, which had a box 4x4x5 feet inside dimensions equipped with three 5-kilowatt electric heaters brought 261 pounds of dairy equipment to a temperature of 170 degrees (Fahrenheit) in 26⅔ minutes. The energy consumption was at a rate of 17.4 kilowatt-hours per hour. Prompt withdrawal of equipment from the sterilizer was found to be desirable in order to allow rapid drying of utensils to avoid rusting. The development of a protective device to prevent the burning out of heating elements in case of lack of water is desirable.

In a study of substitutes for wooden breakpins on tractor drawbars A. H. Hoffman found soft steel rivets to be a satisfactory substitute

J. D. Long reported that the studies of farm fencing showed that concrete posts with wood nailing strips incorporated are failing, and this type of construction appears impractical. Unsurfaced steel posts after four years are rusted, but the strength is not appreciably impaired. Aluminum, oil, and lead painted steel posts are showing rust. Galvanized steel posts show no signs of rust except at the driving end. There appears to be little choice as to shape of steel posts except that I, L and T shapes cut the ground more readily than the round.

E. G. McKibben found in analytical and laboratory studies of simple shock absorbing drawbar springs that a properly selected spring can give satisfactory overload protection at low and medium tractor speeds if the implement is designed to withstand safely a drawbar pull of 1.5 to 2 times the maximum tractive ability of the tractor. At higher speeds a spring is not practical to replace the breakpin, but springs may be used to reduce stresses resulting from increased loads or speeds, and thus reduce the frequency of breakpin replacements. The effectiveness of a spring, strong enough not to be completely compresseed, in preventing increase in the drawbar pull varies as the value of the speed of the tractor times the square root of the product of its weight, times the load-deformation ratio of the spring.

McKibben also found that spring-held overload release hitches should have uniformity of pull for release at given adjustments, and that this pull should be proportional to the adjustment. Such hitches must also be designed for minimum wear of tripping mechanism and with adjustments to overcome wear. These studies indicate there are no fundamental mechanical reasons why such hitches can not be devised to give more satisfactory service than breakpins.

B. D. Moses and E. L. Overholser found, in studies of the temperatures of fruit packed in standard boxes and crates and placed in different locations in cold storage rooms and refrigerator cars, that the factors affecting the rate of cooling are initial fruit temperature, temperature of the storage space, method of wrapping and packing, kind and condition of fruit, and freedom of air circulation.

E. J. Stirniman found in rice drying studies that bound rice placed in shocks lost most of its moisture during the first 80 hours after cutting, while bundles laid flat on the stubble dried out a similar amount in 50 to 55 hours. Very little moisture loss occurred after these periods.

The Quality of Appalachian Hickory, B. H. Paul (Southern Lumberman, 135 (1929), No. 1749, pp. 29-32, figs. 9).—In a contribution from the U.S.D.A. Forest Products Laboratory the results of a quality survey and of mechanical tests of Appalachian hickory are briefly reported.

These show that a high percentage of the Appalachian hickory compares favorably with that from other regions. In general, the average strength of Appalachian hickory compares favorably with hickory from other parts of the country. All Appalachian hickory, however, does not have sufficient strength to meet the requirements of the customary uses of hickory. The second-growth Appalachian hickory which was tested was as high in shock-resisting properties as any hickory previously tested from other parts of the United States.

In the Appalachian region the hickory of low strength was principally in the outer portion of the bole of old virgin-growth trees. Such material was of slow growth and low specific gravity. It usually included all of the sapwood (white hickory) and sometimes a portion of the heartwood. The clear heartwood (red hickory) of the trees of Appalachian forests was usually of good strength.

Hickory having fairly uniform weight and strength was found in trees that had sustained their growth rate from the center outward or in trees that had been sufficiently vigorous to increase their growth rate. A slowing of the growth rate at any period in the life of the hickory trees was accompanied by the production of wood of lower strength.

The high shock-resisting properties of the second-growth Appalachian hickory indicate that the hickory of this region is not inherently of low mechanical strength.

[Irrigation Investigations at the California Station] (California Station (Berkeley), Report 1928, pp. 84-88).—S. H. Beckett reported that the field studies of the consumptive use of water by citrus, avocados and vines have shown that under average irrigation practice in northern San Diego County 60 to 65 per cent of the water applied to an irrigated area serves a useful purpose, the remaining 35 to 40 per cent being lost by surface run-off, evaporation during irrigation and from the soil mulch and deep penetration; that in half of the years over a 50-year period, from one to two irrigations will be needed during the period December to March; and that with winter requirements met by either rainfall or irrigation, mature groves in the interior valleys of San Diego County need for maximum production 18 acre-inches of water per acre to be applied during the summer period April to November.

F. J. Veihmeyer and A. H. Hendrickson, in studies of the effect of late irrigation on the canning quality of peaches, found that differences in soil moisture above the wilting coefficient, even if caused by irrigation within a few days of picking, do not produce differences in the canning quality of the product.

In studies of the residual moisture of 29 soils at permanent wilting of plants by Veihmeyer and Hendrickson, a remarkable constancy has been shown in the residual moisture of any given soil at the beginning of wilting, even under widely varying evaporating conditions. However, the relationship between moisture equivalent and wilting coefficient can not always be expressed by the factor 1.84. While the residual moisture of some soils at wilting closely agrees with the 1.84 ratio, its general use is open to serious criticism. The experimental plants were able to reduce the moisture of different soils to different points prior to permanent wilting, ratios between the moisture equivalent and the wilting coefficient ranging from 1.73 to 3.82.

The investigation by M. R. Huberty of the consumptive use of water by deciduous fruits in the Sacramento Valley showed that during the period April 1 to November 1, consumptive use of water by mature deciduous orchards, planted 24 by 24 feet, is about 24 inches of water per acre.

Rice and cotton irrigation investigations by C. P. Dunshee showed that satisfactory control of early types of water grass in rice fields has been accomplished through seven consecutive years, following without interruption four consecutive years of commercial rice cropping. Growing rice in 96 small plats at the Biggs Rice Field Station, Dunshee and J. W. Jones have shown that submergence to a depth of 10 inches does not kill the white water grass. Tests during three seasons in 18 tanks 27.5 inches in diameter and 4 feet deep indicate that, of the water applied to rice fields, approximately 15 per cent is lost by evaporation from the water surface, 25 per cent by seepage and 60 per cent by transpiration.

AGRICULTURAL ENGINEERING

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Contributions of interest and value, especially on new developments in the field of agricultural engineering, are invited for publication in this journal. Its columns are open for discussions on all phases of agricultural engineering. Communications on subjects of timely interest to agricultural engineers, or comments on the contents of this journal or the activities of the Society, are also welcome.

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RAYMOND OLNEY, Editor

R. A. Palmer, Assistant Editor

Co-Working

COOPERATION among agricultural engineers and between them and other agricultural workers, was re-emphasized at the recent meeting of the North Atlantic Section of the American Society of Agricultural Engineers. Director F. G| Sievers, of the Massachusetts Agricultural Experiment Station, said that the agricultural engineer needs to cooperate with everyone in order to put over his program. He pointed out that outstanding work in agricultural engineering has often been done in cooperation with men in other fields. L. A. Jones, drainage engineer of the U. S. Department of Agriculture, made the point that success in agricultural engineering extension depends upon working with others to accomplish an end without thought of personal gain. In a paper which he prepared but was unfortunately unable to present at this meeting, R. W. Trullinger of the U.S.D.A. Office of Experiment Stations, called for cooperation in agricultural research.

Agricultural engineers need to cooperate with all agricultural scientists—with the economists, sociologists, biologists, chemists, agronomists, and all of their subbranches on problems of planting, tillage, fertilization, pruning, nutrition, feeding, breeding, pest and disease control, harvesting, storage, cleaning, proceessing, marketing, management, income, standards of living, etc.

In some problems the physical conditions may be incidental and the agricultural engineer required merely to assist the scientist concerned in ascertaining, measuring or controlling them. In other cases the physical aspect may be the main feature of the problem and biological scientists and others will return the favor of furnishing incidental information. Then again, many problems will require the active working out of separate but related and equally important phases.

Why all this emphasis on cooperation? Because a problem involving two or more interacting factors cannot be intelligently studied from the standpoint of one of these factors without due regard for the others. The interrelated nature of the factors involved in most agricultural problems is becoming more generally appreciated as science advances.

Transportation Plus

AN INTERESTING attempt is being made by automotive engineers to make possible larger load factors in the operation of trucks by extending their usefulness beyond the transportation field.

If successful this development will make the farm truck more of an object of interest to the agricultural engineer than it has been in the past. The truck has required no special engineering adaptation to make it valuable to the farmer as a transportation unit. But before the suggestions to make the truck a towing unit and a source of auxiliary power can become realities on the farm, power take-offs, pintle hooks, and auxiliary equipment for special jobs will have to be developed to meet farm conditions and requirements.

There is an opportunity for this kind of equipment. Many farmers own trucks but cannot keep them busy to the extent that would be most profitable. Others would like to own trucks but do not have quite enough work for them to justify the investment. These same farmers have field machines which need to be moved from one point of use or storage to another with a minimum waste of time. The properly equipped truck would be valuable as a supplementary or reserve power unit for the isolated and temporary or periodic belt jobs which require a flexible and mobile power unit. The farm tractor or tractors might fail or be otherwise occupied when they are most needed for belt work. On large farms power tool-sharpening equipment, drills, etc., for making field repairs would be profitable accessories for the farm truck. Attachments for special jobs, corresponding to the pole-setting equipment already in use by telephone and power companies and the snow-moving apparatus on highway department trucks, might also be used to save time and cut down investment overhead.

Development of a farm truck with usefulness beyond the field of transportation may be expected as soon as the number of power farmers has increased enough, and their activities, equipment and practices have become standardized enough to warrant quantity production. Its special features will necessarily be developed by agricultural engineers.

The Virtue of Work

IN TIMES past hard work was the only known means of self-support. Under those conditions hard work became so firmly established as a virtue that many people came to think of work as virtuous for its own sake. They gave little thought to increased accomplishment and scorned easy ways of doing things.

Agriculture has suffered an unduly long hangover of this idea. That it is finally dissipating before the influx of scientific and engineering developments gives real cause for agricultural optimism.

Director F. G. Sievers, of the Massachusetts Agricultural Experiment Station, in speaking at the Amherst meeting of the North Atlantic Section of the American Society of Agricultural Engineers, pointed out that modern agriculture demands a new viewpoint on work and leisure; that farmers accomplish more now with less fatigue and with greater interest; that work by modern methods and measuring up to modern standards of efficiency requires more planning. Farmers must have at least enough leisure to do this planning and many of them are finding it worth while to take more.

Agricultural engineers may well take satisfaction in the part they have taken in making leisure possible for the farmer.

Who's Who in Agricultural Engineering

W. W. Weir

F. P. Hanson

H. R. Linn

Wm. Aitkenhead

W. W. Weir

Walter Wallace Weir (Mem. A.S.A.E.) is associate drainage engineer on the staff of the California agricultural experiment station, in charge of research and extension in drainage, alkali reclamation and soil erosion. After graduating in civil engineering at the University of California in 1907 he entered government service as assistant drainage engineer in the Department of Agriculture; was later promoted to positions as drainage engineer and senior drainage engineer, with assignments in the Mississippi delta states and in Washington; in 1914 was sent to California to take charge of alkali reclamation in the San Joaquin valley; in 1917 was transferred to the position of assistant professor of soil technology at the University of California, and has grown from that to his present position without any material change in activity. He is author of the present drainage district laws in both Washington and California, of a number of experiment station bulletins and circulars on drainage and of several articles on the same subject in various publications, including AGRICULTURAL ENGINEERING. He is active in the work of the Reclamation Division and is at present secretary of the Pacific Coast Section of the Society.

F. P. Hanson

Frank Paul Hanson (Mem. A.S.A.E.) is agricultural engineer in the training department of the Caterpillar Tractor Company. A native of Iowa, he received his bachelor's degree in agricultural engineering at Iowa State College in 1920. At that time AGRICULTURAL ENGINEERING was about to be launched as an enterprise of the Society and Mr. Hanson, having been an active student member, was engaged as assistant secretary to help take care of the increased work. The following year he was made secretary-treasurer. In 1922 he was employed by the Portland Cement Association but continued to serve as treasurer of the Society for the year. After about a year he stepped from this connection to the position of extension specialist in farm mechanics at the University of Illinois. When the Caterpillar Tractor Company began reaching out for agricultural engineers in 1927, it placed him with the sales department of its subsidiary, the Western Harvester Company, and has since shifted him to his present position in the educational department of the parent company. His varied agricultural engineering experience and close contact with the Society has placed him among the best known of its younger members.

H. R. Linn

Homer Roberts Linn (Mem. A.S.A.E.) is heating engineer in the western executive office of the American Radiator Company, at Chicago. After earning his bachelor's degree in mechanical engineering at the University of Illinois in 1896 he became chief draftsman in the Cleveland, Ohio, office of the motive power department of the New York Central Railroad. After six years he left this position to become a member of a Chicago firm of consulting mechanical and electrical engineers, with which he remained for five years. During this time, in 1906, the University of Illinois awarded him his master's degree in mechanical engineering. Since then he has held several different positions in designing and sales engineering work with heating system manufacturers. When he became associated with the American Radiator Company in 1926 he became interested in rural plumbing and heating problems and joined the A.S.A.E. Since then he has been active in the work of the Structures Division and is at present chairman of its committee on farm home heating. He is also active in the work of the American Oil Burner Association and the Illinois Master Plumbers Association to improve rural living conditions.

Wm. Aitkenhead

William Aitkenhead (Mem. A.S.A.E.) is professor and head of the department of agricultural engineering at Purdue University. He was born and reared on Hurlawcrook Farm, East Kilbride, Scotland. He served a five-year apprenticeship in the Victoria Implement Works. At its conclusion in 1894, he came to the United States and obtained employment as a machinist with the Missouri, Kansas and Texas Railway, at Parsons, Kansas. After four years he entered Purdue University and graduated in mechanical engineering in 1902. Then for several years he worked with the American Locomotive Company at Richmond, Virginia, and elsewhere. Getting back into college work, he spent three years as assistant in the department of physics, Washburn College, Topeka, Kansas. From Washburn he went to the University of Oklahoma and took charge of its engineering shops. Five years were spent at this institution. In 1913 he obtained the degree of master of arts from the University of Oklahoma, and also the degree of mechanical engineer from Purdue University. Since 1914 when he accepted his present position, he has given his attention to agricultural engineering, and since 1915 has been active in the work of the Society.

A. S. A. E. and Related Activities

PROGRAM

Meeting of the
Land Reclamation Division
American Society of Agricultural Engineers

Hotel President, Kansas City, Missouri, December 30 and 31, 1929

Forenoon and Afternoon — Monday, December 30

9:30 a.m. and 2:00 p.m. Simultaneous Sessions on

1. Soil Erosion Control

G. E. Martin, presiding

"Soil Erosion Control Work on the Guthrie (Okla.) Project"—C. E. Ramser, senior drainage engineer, U. S. Department of Agriculture

"Terracing Problems in the Corn Belt States" — C. K. Shedd, extension agricultural engineer, University of Missouri

"Late Developments for the Prevention of Soil Erosion in Mississippi" — J. T. Copeland, extension agricultural engineer, Mississippi A. & M. College

"A Statewide Program for Extension Work in Soil Erosion Control" — G. E. Martin, agricultural engineering specialist, Oklahoma A. & M. College

"Some Preliminary Work on a New System of Terracing"—M. L. Nichols, professor of agricultural engineering, Alabama Polytechnic Institute

Round Table Discussions of Soil Erosion Control Problems

2. Drainage

R. B. Roe, presiding

"The Solution of an International Drainage and Flood Control Problem"—E. V. Willard, commissioner of drainage and waters, State of Minnesota

"Rehabilitation of Drainage and Levee Districts"—Clark E. Jacoby, president, Clark E. Jacoby Engineering Co.

"Influence of Drainage on Forest Growth"—P. C. McGrew, assistant drainage engineer, U. S. Department of Agriculture

Round Table Discussions of Drainage Problems

3. Irrigation

M. R. Lewis, presiding

"Work of the Bureau of Reclamation in Providing Supplemental Water for Irrigation" — Dr. Elwood Mead, commissioner of reclamation, U. S. Department of the Interior

"Relation of Length of Drought Period to Need of Irrigation" — J. C. Russel, department of agronomy, college of agriculture, University of Nebraska

"Use of Deep Wells and Pumps for Drainage and Supplemental Irrigation Water" — E. H. Neal, irrigationist, University of Idaho

"Irrigation in the Eastern United States" — (speaker to be selected)

Round Table Discussions of Irrigation Problems

4. Land Clearing

N. A. Kessler, presiding

"Land Clearing as a Part of the Development of a Farm Machinery Program in the South" — A. T. Holman, agricultural extension engineer, North Carolina State College

"A Land Clearing Investigational Program in the State of Washington" — L. J. Smith, professor of agricultural engineering, State College of Washington

"Teaching the Use of Explosives to College Students" — George Amundson, specialist in agricultural engineering, Michigan State College

"Results of Land Clearing Investigations in Minnesota" (Cooperative Work between the University of Minnesota and the U.S.D.A. Bureau of Public Roads) — N. A. Kessler, associate land clearing specialist, Bureau of Public Roads, U. S. Department of Agriculture

Round Table Discussions of Land Clearing Problems

Forenoon — Tuesday, December 31

9:30 a.m. General Session

Ivan D. Wood, chairman, A.S.A.E. Land Reclamation Division presiding

"The Engineering Factor in Land Reclamation"—W. G. Kaiser, president, American Society of Agricultural Engineers

"The Engineer's Contribution to Agriculture" — Clarence Roberts, editor, "Oklahoma Farmer-Stockman"

"The Cost of Droughts on the Great Plains"—Joseph B. Thoburn, curator, Oklahoma Historical Society

"Economic Justification for Reclamation Activities"—Dr. Elwood Mead, commissioner, Bureau of Reclamation, U. S. Department of the Interior

Afternoon — Tuesday, December 31

2:00 p.m. **General Session**

"The Use of Supplemental Water"—J. C. Russel, agronomy department, college of agriculture, University of Nebraska

"The Rehabilitation of Irrigation Districts" — W. W. McLaughlin, associate chief, Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture

"Sedimentation Factors in Flood Control, Drainage and Reclamation" — Roy N. Towl, Towl, Nelson & Schwartz, consulting engineers

"Are There Too Many Farms?" (An answer to the fallacy of overproduction) — E. R. Jones, professor of agricultural engineering, University of Wisconsin

Business Session

American Engineering Council

PRESIDENT HOOVER recently issued a statement to the effect that topographic coast and geodetic surveys of the United States are to be completed within 18 years rather than within 20 years as originally planned.

Efforts of the American Engineering Council are largely responsible for the expediting of these surveys. The executive secretary had conferences with the Secretaries of the Interior and Commerce and the Director of the Budget, and pointed out to them the need of increased appropriations for the topographic and water resources work of the U. S. Geological Surveys and for the Hydrographic Survey branch of the Coast and Geodetic Survey. Subsequently a suitable plan was worked out by Secretaries Wilbur and Lamont for strengthening this work approximately $1,000,000 per year.

Data provided by these surveys are important to the successful development of such engineering projects as city planning, improved highways, irrigation, hydro-electric systems, improvement of rivers for navigation, and flood control.

At its meeting in Washington, D. C., October 24 and 25, the administrative board heard and considered routine and special committee reports. The patents committee reported on various bills affecting that situation. On the subject of "airports" the research committee recommended that the Council make a cooperative study with the Bureau of Aeronautics, Department of Commerce; a special committee approved this report and recommended the appointment of a committee to confer with the Bureau of Aeronautics and work out a plan for formulating a report for the general information and guidance of public bodies and other interested parties. The Council adopted this recommendation.

Council will designate one or two advisors to the board of directors of the Rosenwald Industrial Museum. This was made certain when the administrative board approved a recommendation of the executive committee.

Proposals to secure a fitting memorial for Major Charles Pierre L'Enfant, who planned the Capital City, were approved in principle, although pending legislation on the subject was reported as unsatisfactory. Endorsement was given to the Crampton Bill (H.R. 26) providing for a memorial parkway along the Potomac and a comprehensive park and playgorund system for the National Capital. The restoration of some of the engineering works of George Washington was approved as a further appropriate recognition of the 200th anniversary of his birth.

More than 25 pending bills were considered by the public affairs committee. Among these were four for the promotion of research in the utilization of agricultural products and by-products. Bills for the promotion of the St. Lawrence waterway project were approved in principle and the recommendation made that civilian as well as army engineers be appointed on the commission provided for in the measures. The executive secretary was instructed to take appropriate action to secure the appointment of civilian engineers to the International Joint Commission.

January 9, 10 and 11, 1930, were set as the dates for the annual meeting of the Council.

The
International
Harvester
FARMALL
has
21
New Departure
Ball Bearings
PULLING ROTARY HOES
MOWING
PLANTING
STACKING HAY
OPERATING BINDER
MIDDLE BUSTING
SILO FILLING
OPERATING SWEEP RAKE
CULTIVATING
PLOWING
NOTHING ROLLS LIKE A BALL
1324

Necrology

George Charles Kreutzer succumbed to an attack of angina pectoris on November 23, at the age of 45. He was born in Colorado and earned his bachelor's and master's degrees in civil and irrigation engineering at Colorado Agricultural College. During the years from 1911 to 1915 he was in Victoria, Australia, in various engineering capacities in connection with public irrigation work. After he returned to the United States he applied his knowledge for several years in California. In 1924 he was appointed by Dr. Elwood Mead as director of reclamation economics, Bureau of Reclamation, U. S. Department of the Interior, which position he held until his untimely death. Mr. Kreutzer became a member of the Society in 1924 and served it along the line of his special interests, land settlement and colonization.

New A.S.A.E. Members

James K. Alvis, agricultural sales, Caterpillar Tractor Co., Peoria, Ill.

Edward A. Cockey, Jr., manager, Worthington Valley Farms, Cockeysville, Md.

Joseph E. Cress, research fellow, University of Idaho, Moscow, Ida.

Albert V. Krewatch, electrical engineer, National Rural Electric Project, College Park, Md.

Rene Hauzeur, writer, Carresa 9, No. 490, Chapinero, Bogota, Colombia, So. Am.

Howell E. Lacy, research engineer, Georgia State College of Agriculture, Athens, Ga.

Daryl B. Leonard, agricultural agent, Pacific Power & Light Co., Walla Walla, Wash.

Paul V. Morrissey, agricultural sales department, Caterpillar Tractor Co., Peoria, Ill.

C. V. Phagan, assistant extension agricultural engineer, Oklahoma A. & M. College, Stillwater, Okla.

Burwell B. Powell, economist and sociologist, National Rural Electric Project, College Park, Md.

Wilhelm Vutz, designer, J. I. Case Company, Racine, Wis.

Henry C. Yawn, Jr., industrial engineer, Pearl River Valley Lumber Co., Hammond, La.

Transfer of Grade

E. L. Ocock, instructor, Northwest School and Station, University of Minnesota, Crookston, Minn. (Student to Junior Member.)

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the November issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

John A. Chater, chief engineer, Niagara Sprayer and Chemical Co., Inc., Middleport, N. Y.

Raymore D. MacDonald, agricultural machine designer, The Ann Arbor Machine Co., Shelbyville, Ill.

Ralph D. Mancinelli, assistant to chairman of standards committtee, International Harvester Co., Chicago. Ill.

Sarkis M. Nahikian, sales manager, Blood-Brothers Machine Co., Allegan, Mich.

Transfer of Grade

Clarence R. Zink, student trainee, Public Service Co. of Northern Illinois, Chicago, Ill. (Student to Junior Member.)

Personals of A.S.A.E. Members

W. A. Clegg, until recently associate professor of agricultural engineering, University of Georgia, is now engaged in sales promotion work in the southern and eastern states with the Caterpillar Tractor Company. Until March 1, 1930, he will be conducting "Caterpillar" schools in the southeast. His address is 126 Hampton Street, Athens, Georgia.

O. E. Hughes is now extension agricultural engineer at the Georgia State College of Agriculture, Athens, devoting his time principally to farm machinery, terracing and drainage. He was formerly salesman with the J. I. Case company in the South Carolina territory.

W. M. Hurst, assistant agricultural engineer, Division of Agricultural Engineering, U.S.D.A., is author of Farmer's Bulletin No. 1608 entitled "The Operation and Care of the Combined Harvester-Thresher."

Earl G. Johnson is now extension specialist in farm mechanics at the University of Illinois, most of his time being devoted to soil erosion and water supply and sewage disposal demonstrations. He was formerly connected with the University of Missouri as an agricultural engineer.

L. L. Koontz, who received a bachelor's degree in electrical engineering from Virgina Polytechnic Institute in 1928 and a master's degree in agricultural engineering from the same institution the following year, is now in charge of the rural service department of the Shenandoah River Power Company, having approximately 600 miles of rural lines to cover in his rural electrification work. His address is Harrisburg, Virginia.

H. W. Le Mert, until recently farm power manager, promoting rural electrification work with the Missouri Power & Light Company, Kansas City, Missouri, has accepted a position as associate professor of agricultural engineering at the Mississippi Agricultural and Mechanical College.

J. D. Long, junior agricultural engineer, University of California, is author of California Agricultural Experiment Station Bulletin No. 472, entitled "Adobe Construction." The bulletin reviews the subject in a thorough manner and gives information on construction details and recommended practices.

Employment Bulletin

An employment service is conducted by the American Society of Agricultural Engineers for the special benefit of its members. Only Society members in good standing are privileged to insert notices in the "Men Available" section of this bulletin, and to apply for positions advertised in the "Positions Open" section. Non-members as well as members, seeking men to fill positions, for which members of the Society would be logical candidates, are privileged to insert notices in the "Positions Open" section and to be referred to persons listed in the "Men Available' section. Notices in both the "Men Available" and "Positions Open" sections will be inserted for one month only and will thereafter be discontinued, unless additional insertions are requested. Copy for notices must be received at the headquarters of the Society not later than the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. There is no charge for this service.

Positions Open

WRITER, with farm experience; agricultural engineering background an asset. Applicant should be capable of preparing feature stories for farm papers. In replying, please furnish samples of work. PO-165.

Men Available

AGRICULTURAL ENGINEER, graduate of a French university and a well known American automotive school in the East, American citizen, single, age 31, specialized in selling tractors, agricultural implements, and automobiles, speaks fluent French, English and Near-Eastern languages, also working knowledge of Spanish, extensively traveled in Europe, desires making connection with a concern in their export department. Willing to go anywhere. MA-166.

ANOTHER MANUFACTURER OF AGRICULTURAL MACHINERY
THAT USES **SKF** BEARINGS

Gleaner Combine Harvester Corporation

Equipped with the highest priced bearing in the world
YOU MAY BUY A BEARING AS A BARGAIN BUT TRY AND GET A BARGAIN OUT OF USING IT
for
Nothing is apt to cost so much as a bearing that cost so little.
SKF
Puts the Right Bearing in the Right Place

At Harvesting Time You'll Readily See Why SKF Bearings Are Really Worth Their Cost

FOR the Countershaft of the Gleaner Baldwin Combine . . . . . there was only one choice . . . SKF Self-Aligning Ball Bearings. Years of experience have proven this the logical bearing for that location. For one thing, it is the only bearing which possesses the inherent characteristic of rolling self-alignment. It does this without pinching, heating or binding. On the countershaft the importance of this feature cannot be overestimated, especially when you consider the stresses met with in the field.

Then too, the precision of SKF Bearings remains unchanged, they show no wear season after season and never require adjustments. With all these outstanding qualities, the smooth running of SKF Bearings remains unimpaired for they have the long-life and ruggedness to stand the shocks of hard service. Just an infrequent replenishing of lubricant and every owner of a Gleaner Baldwin combine can be sure that SKF Bearings will do more than their share to get the grain out without trouble at harvesting time.

SKF INDUSTRIES, INC., 40 East 34th Street, New York, N. Y. 2434

SKF
Ball and Roller Bearings

LINK-BELT CHAINS *for*

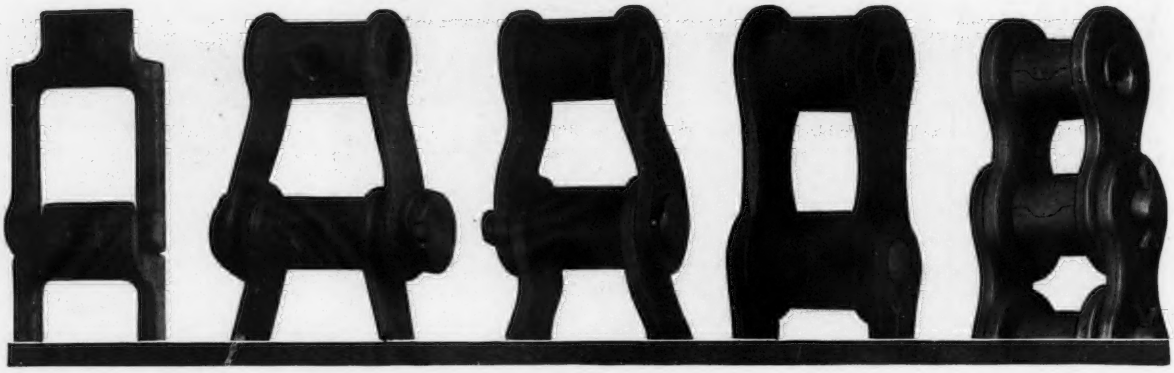
COMBINES

BINDERS

CORN PICKERS

MANURE SPREADERS

THRESHING MACHINES



Chains *for* Every Purpose Under the Sun

Since Ewart Link-Belt was originated by us more than fifty years ago, we have designed and manufactured all types of conveying and drive chains — the Ewart Detachable Link-Belt, the "400" Class Pintle Chain, the "EC" Class All-Steel Chain, the "RC" Class finished Roller Chain and numerous others.

We are therefore free to recommend the type of chain which will most effectively and most economically accomplish the results.

There is a standard Link-Belt Chain for every elevating, conveying and power transmission service.

Our large chain stocks assure prompt shipment.

LINK-BELT COMPANY · 200 South Belmont Avenue · INDIANAPOLIS, IND.
Leading Manufacturers of Elevating, Conveying and Power Transmission Chains and Machinery

3724

LINK-BELT

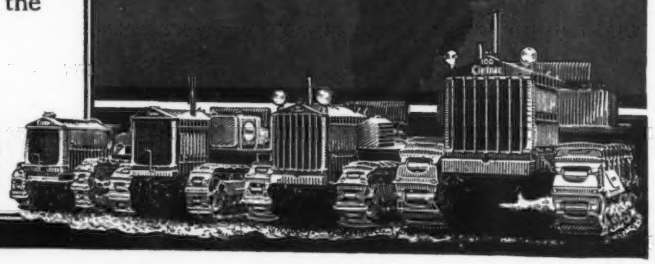
Cletrac

A name the whole world knows!

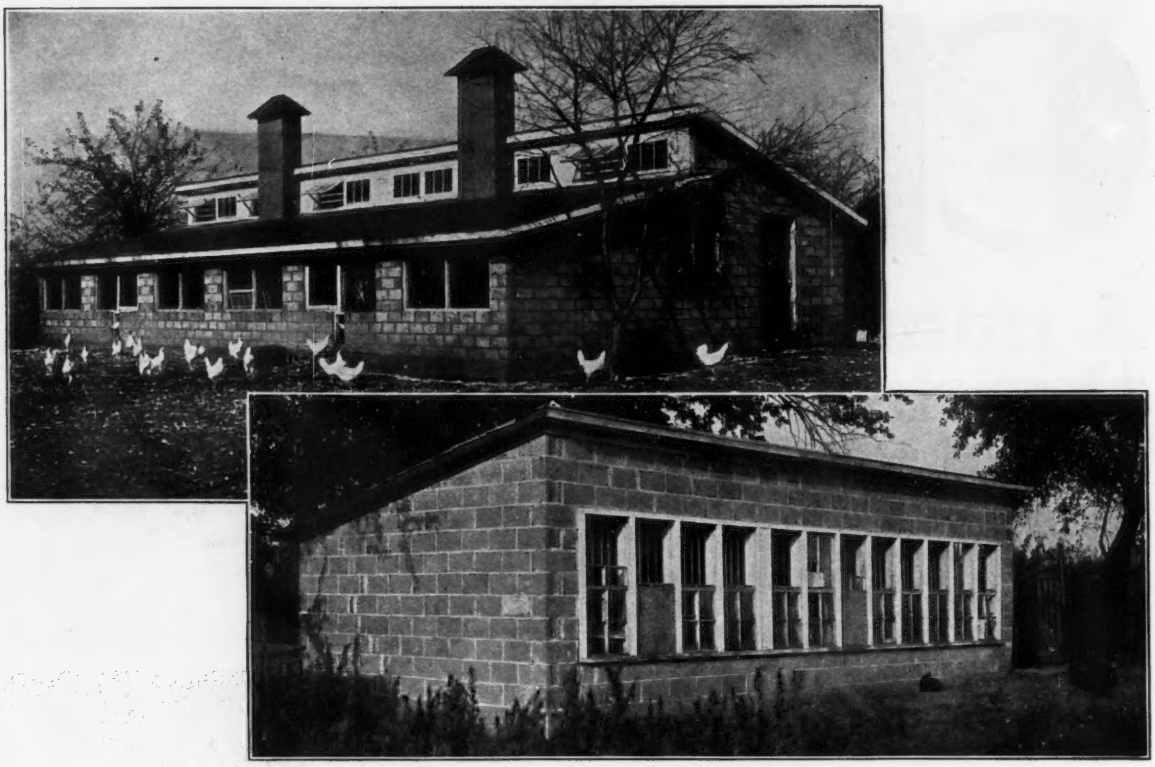
NOT only in their homeland but throughout the world Cletrac Crawler Tractors have achieved outstanding fame. Serving tens of thousands of owners in more than seventy countries these powerful, efficient tractors are speeding up work and reducing costs in many kinds of businesses.

In agriculture Cletracs are the ideal tractors for all field operations from plowing time to harvest. Providing an abundance of power with the added features of positive traction and all-weather usefulness they offer a value second to none in the farm tractor field.

Built in a complete line from 12 to 100 h.p. Write for literature and name of nearest distributor.



THE CLEVELAND TRACTOR CO.
19318 Euclid Ave. Cleveland, Ohio



Concrete Masonry Walls Make Dry Poultry Houses

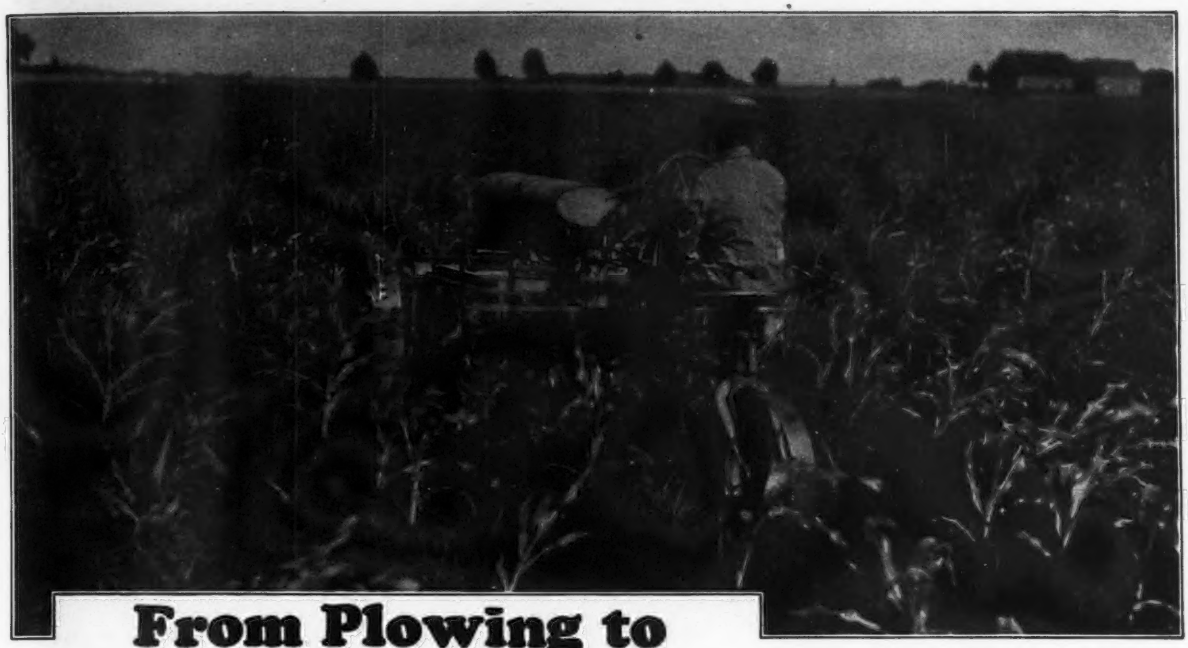
Hollow wall construction, so much desired in the building of fine homes, offers equal advantages in the building of modern poultry houses. Concrete masonry units, because of their hollow cores, provide walls whose inner and outer surfaces are separated by dead air space.

Here is natural insulation against extremes of temperature —a rigid, tightly-sealed wall which air or dampness will not penetrate—a barrier to fire, from within or without—a permanent wall requiring little, if any, maintenance.

Poultry houses of concrete masonry are contributing to good poultry production in practically every part of the country. When properly built they can safely be recommended by agricultural engineers as thoroughly practical from every viewpoint. Plans and full information are available in Portland Cement Association literature.

PORTLAND CEMENT *Association*

Concrete for Permanence and Firesafety CHICAGO



Advance Rumely
DoAll Tractor

From Plowing to Cultivating Corn

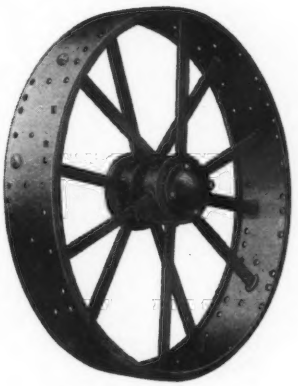
THE all-purpose tractor is now a necessity upon thousands of farms. Its uses are endless, for the farmer's work is never done—one operation must follow another throughout the summer.

One of the important factors in the adaptability and efficiency of the general purpose tractor are the wheels. French & Hecht Steel Spoke Wheels are designed to meet the mechanical requirements of these machines under all field and soil conditions, thus contributing to better traction, higher efficiency, and improved quality of work.

In French & Hecht Steel Wheels, the spokes are fastened to the hubs by a highly developed process which assures greater strength and rigidity against all strains encountered in service. These wheels withstand the hardest uses and are practically permanent.

Extreme accuracy in construction of wheels and bearings reduces rolling resistance and adds to the operating economy and life of the machine itself.

So efficient are French & Hecht manufacturing facilities that a distinct saving in cost of Wheels can be effected in most instances for manufacturers of any wheeled equipment. The vast engineering experience and facilities of this organization are always available to manufacturers.



French & Hecht Steel Wheels offer distinct advantages for tractors and farm implements of all kinds. They are stronger and more durable—there is no loosening of spokes, and no yielding or distortion of wheel with continued use.

FRENCH & HECHT, Inc. DAVENPORT, IOWA SPRINGFIELD, OHIO

Wheel Builders Since 1888

FRENCH & HECHT

STEEL WHEELS

A Team or Two for the Odd Jobs—
That's All When the General Purpose Is Used

When the farmer can plant from 30 to 40 acres a day—

—when he can cultivate from 25 to 40 acres

—when he can plow, disk, hoe, mow, harvest, thresh, pick corn, fill the silo, grind feed—do all these jobs with his John Deere General Purpose Tractor—the need for horses fades from the farming program.

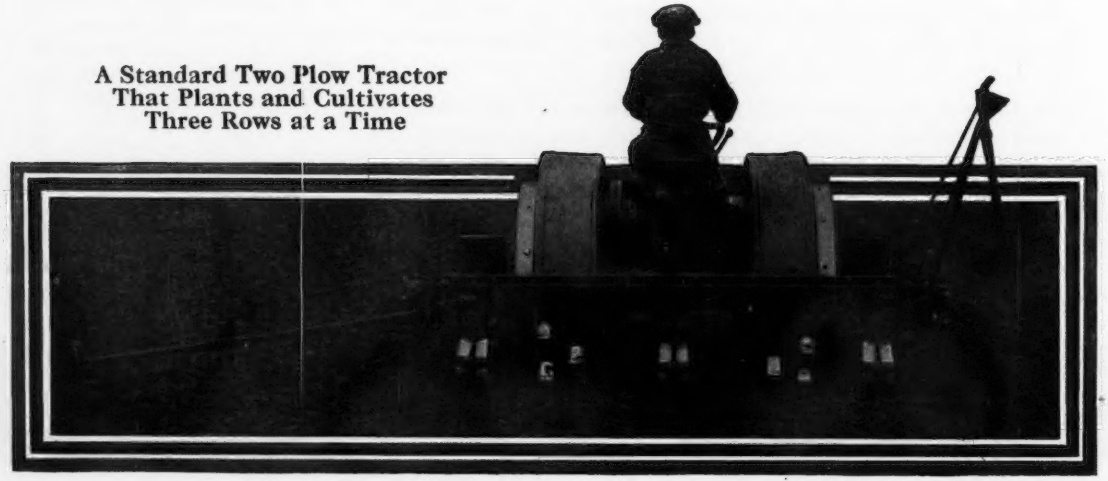
Usually one team, two at the most—for the odd jobs around the farm—fills out his power requirements when he has the General Purpose.

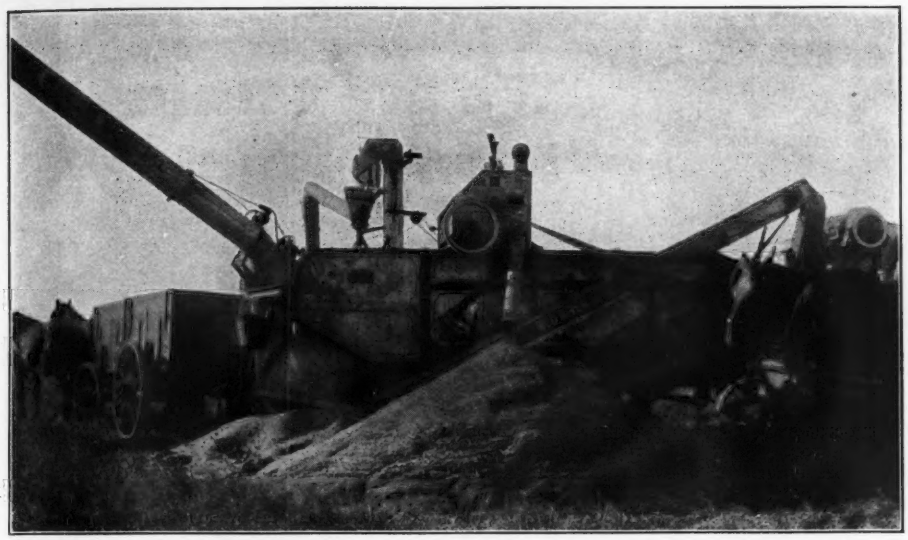
What is equally important, he is no longer confronted with the help problem—he does away with this big expense item that has kept down his net returns.

Because he can do his work under the most favorable conditions, he gets bigger yields. The John Deere General Purpose with equipment built to use with it is giving the row-crop farmer the utmost in mechanical power.

JOHN DEERE, MOLINE, ILLINOIS

A Standard Two Plow Tractor That Plants and Cultivates Three Rows at a Time





Carter equipped Red River Special owned by Adolph Baune, thresherman, Willow City, N. Dak., threshing and cleaning for Tom Anderson, Minot, N. Dak., with pile of dockage removed from the grain in foreground.

CARTER DISC ReCleaner

Performance Report No. 1*

CARTER DISC RECLEANER On Red River Special

The illustration above and the letter below tell the story more completely and convincingly than mere words.

". . . Your Carter Disc ReCleaner is making history in this territory, and the farmers think it is a wonder. On one job of 500 acres I removed 1000 bushels of good clean wild and volunteer oats. This was taken from durum and these oats are worth right now 25c per bushel or $250 for the lot.

"Mr. Anderson, who knew what a Carter would do, waited three weeks for me to do his threshing. I have all the threshing I can handle, while others are all through. My Carter ReCleaner has already paid for itself this year . . . ." —ADOLPH BAUNE.

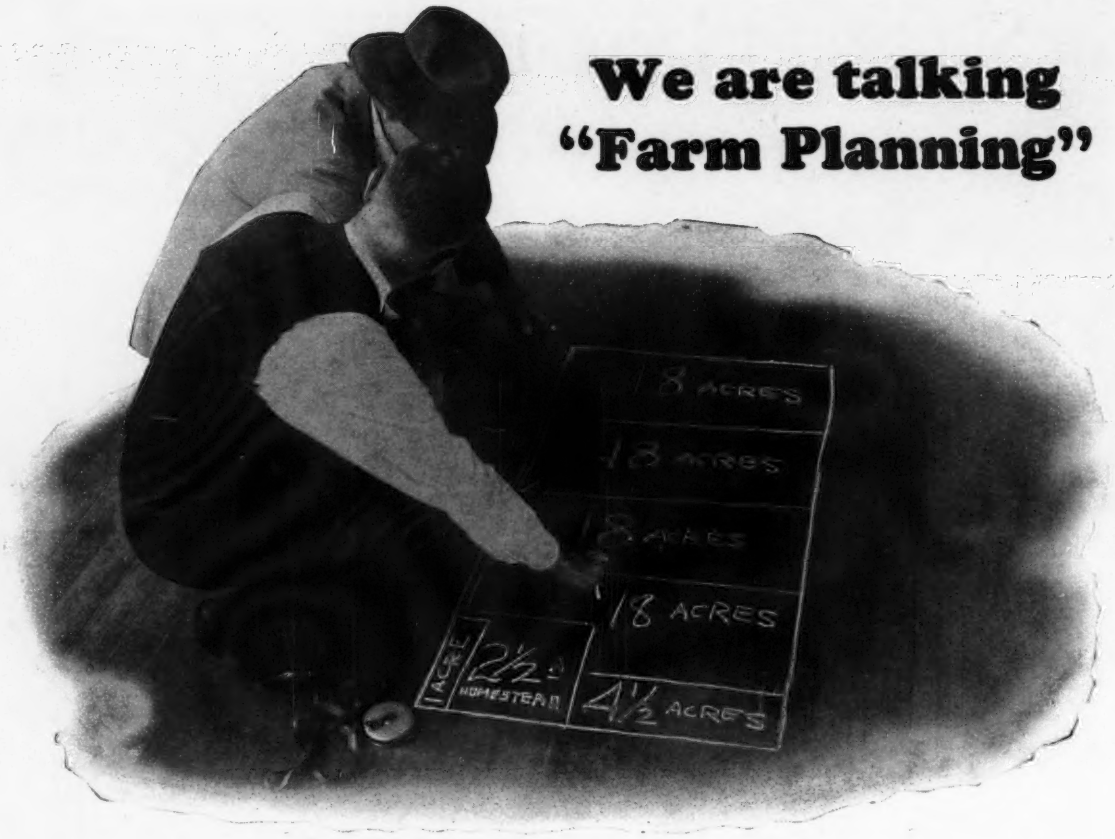
*Performance report of the Carter Disc ReCleaner on other well-known threshers will appear in this magazine from month to month.

Carter-Mayhew Mfg. Co.

Division of HART-CARTER CO.

640 Nineteenth Avenue N. E., Minneapolis, Minn., U. S. A.

America's Largest Manufacturers of Grain Cleaning Equipment



We are talking "Farm Planning"

WE ARE trying to carry over to farm folks educational suggestions on "Farm Planning." Farm publications, radio, direct mail, motion pictures—all are being used. To what end?

First, to make more profits for farm folks. Second, as a food and soil fertility service for this country's rapidly growing population.

We are telling your members that only with stock-tight fence is a definite farm plan possible; that every field must be fenced stock-tight—to rotate crops, hog down, pasture after harvest, clean out weeds with sheep, fertilize on the hoof, save missed corn and down grain; to raise what is fed and feed what is raised; to market on the hoof in place of on wheels.

Valuable Farm Planning Book

We have literature that will help you with your "farm planning" talks. Successful farmers in fifteen states contributed the material for this interesting, illustrated book on "Farm Planning." Describes actual, successful Farm Plans. Covers proper crop rotation. Shows value of legumes. How marketing crops on the hoof brings extra profits and builds up soil fertility through natural fertilization. You are invited to write for one of these special edition books.

Made in both stiff stay and hinge joint styles.

Keystone Steel & Wire Co.

9467 Industrial St. Peoria, Ill.

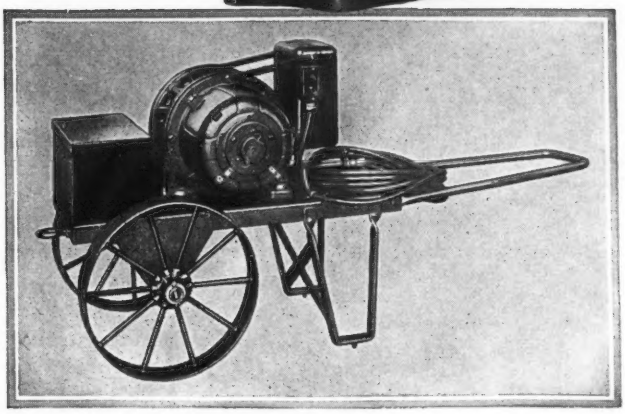
For Simplicity, Dependability, Economy *select the* SCR

Whenever you purchase motors or motor-driven machinery for operation on single-phase circuits, it will pay you well to specify SCR —General Electric's single-phase motor.

SCR motors are the simplest single-phase motors built—different from all others in that they have no short-circuiting switches, brush-lifting mechanisms, or other devices to go wrong.

They operate even when the voltage is low—and will not shut down your machinery on temporary voltage dips.

They keep down the power bills; they require very little attention; and they operate with that reliability that is typical of all G-E motors.



Above: *Type SCR single-phase motor suitable for application to farm machinery*

Below: *G-E portable farm motor—a convenient unit for driving belted farm machines where a permanently attached motor is not justified*

Farm implement manufacturers will, at your request, supply devices with Type SCR motors attached, or they may be obtained direct by writing to your power company.

204-12

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

Cooking in Comfort

INVESTIGATION shows that the average farm homemaker spends over 70% of her time in the kitchen. She spends more time in preparing meals than in any other task. A good fuel for cooking will help give her time for much needed recreation. In Carbide Gas she will find the six requirements of a good cooking fuel:

1. Safety
2. Accurate control of heat
3. Comfort for the worker
4. High heat value
5. Cleanliness
6. Reasonable cost

Engineering is having a marked influence in the reorganization of agriculture. But agriculture as a business can not reach its greatest heights until the homes back of it are reorganized too.

The women in these homes are looking to the agricultural engineer for advice. You should be ready to give them the help they need. Investigate fairly and thoroughly the economic advantages of Carbide Gas as a fuel for farm home kitchens. You will find that it brings to every farm home modern lighting and modern ironing, as well as modern cooking.

Take time now to write this association for complete information about Carbide Gas.

CARBIDE LIGHTING AND EQUIPMENT ASS'N

176 West Adams Street Chicago, Ill.

Carbide Lighting and Equipment Association
176 West Adams St., Chicago, Ill.

Without incurring the slightest obligation, I would like further detailed information on Carbide Gas.

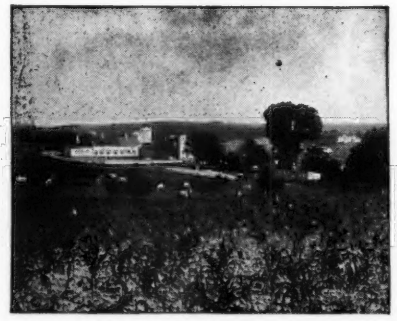
Name _____

Street and No. or R. F. D. _____ *Town* _____ *State* _____

THESE FACTS SAY "Build with Lumber"

The farm of Charles H. Putnam, who received the first Distinguished Service Award of the American Farm Bureau Federation. All buildings are of wood. "Lumber construction has demonstrated itself to be worthwhile," says Mr. Putnam.

Lumber was chosen as the ideal material for every building but one on the farm of Charles E. Hearst, President of the Iowa Bureau of the American Farm Bureau Federation.



Farm of Hugh G. Van Pelt, famous livestock owner, breeder and judge. "For dairying and the breeding and development of livestock, I would recommend buildings of lumber," says Mr. Van Pelt.

BENEATH the white light of actual experience . . . with the results weighed by the keenest minds in American agriculture today . . . your favorite building material, lumber, meets every test.

On farms like these . . . practical, successful farms conducted by men whose opinion commands the respect of every progressive farmer in America . . . lumber . . . through its actual performance . . . is preferred.

When you advise, "Build with Lumber," you have the assurance that the experience of these men adds the weight of their advice to your wise counsel.

Know the Lumber You Use

And now . . . a new safeguard for your lumber specifications! The National Lumber Manufacturers Association guarantees to the dealer that lumber bearing its symbol, the "Tree-Mark" is of the quality indicated thereon by the official marks of the expert grader, that it is carefully manufactured "American Standard Lumber from America's Best Mills."

Your client is assured of getting exactly the grade and species of lumber you specify as being best for his needs.

The advice of experts in wood technology, trained in the agricultural field, is available to you, to help you solve your construction problems. Their help is given without cost to you.

Two valuable booklets are yours for the asking.

They tell you worthwhile facts about many phases of agricultural construction. The coupon brings them FREE.

★ ★

Lumber is now easily identified in every grade (quality) and species (kind). The "Tree-Mark" stamped on lumber is your guarantee that the marks of the expert grader are correct . . . that it is "American Standard Lumber from America's Best Mills."

National Lumber Manufacturers Association
Dept. 2508, Transportation Bldg.
Washington, D. C.

Gentlemen: Please send me these FREE booklets: "Taking the Mystery Out of Lumber Buying," and "The Use of Lumber on the Farm."

Name_____

Address_____

City_____ State_____

NATIONAL LUMBER MANUFACTURERS ASSOCIATION
Washington, D. C.

THESE 18 great associations affiliated with the National Association maintain particular information and service organizations that coordinate with the general service of the National staff.

†California Redwood Association, San Francisco, Calif.—Redwood

*California White & Sugar Pine Manufacturers Association, San Francisco, Calif.—California Pines, White Fir

Hardwood Manufacturers Institute, Memphis, Tenn.—Oak Gum,*Tennessee Aromatic Red Cedar, Southern and Appalachian Hardwoods

*North Carolina Pine Association, Norfolk, Va.—North Carolina Pine

*Northern Hemlock & Hardwood Manufacturers Association, Oshkosh, Wis.—Hemlock, Maple, Birch and Northern Hardwoods

*Northern Pine Manufacturers Association, Minneapolis, Minn.—White Pine, Norway Pine

*Southern Cypress Manufacturers Association, Jacksonville, Fla.—Cypress and Tupelo

*Southern Pine Association, New Orleans, La.—Long Leaf and Short Leaf Southern Yellow Pine

*West Coast Lumbermen's Association, Seattle, Wash.—Douglas Fir, Sitka Spruce, West Coast Hemlock, Western Red Cedar

Red Cedar Shingle Bureau, Seattle, Wash.

*Western Pine Manufacturers Association, Portland, Ore.—Pondosa Pine, Idaho White Pine, Larch

National American Wholesale Lumber Association, New York, N. Y.

National Association of Wooden Box Manufacturers, Chicago, Ill.

*Maple Flooring Manufacturers Association, Chicago, Ill.

British Columbia Lumber and Shingle Manufacturers, Ltd., Vancouver, B. C.

British Columbia Loggers Association, Vancouver, B. C.

American Wood Preservers' Association, Chicago, Ill.

*Oak Flooring Manufacturers Association of the United States, Chicago, Ill.

*Grade- and trade-marked lumber available in these species †Trade-marked lumber available in these species

Great Emancipators

—*the Reaper in* 1831 *and now the*

FARMALL

A HUNDRED YEARS AGO, while men and women toiled for their daily bread in the fields of the world, Cyrus Hall McCormick built a strange machine which did the work of several men. That machine was the McCormick Reaper. On the heels of the Reaper, both Agriculture and Industry leaped forward with great strides.

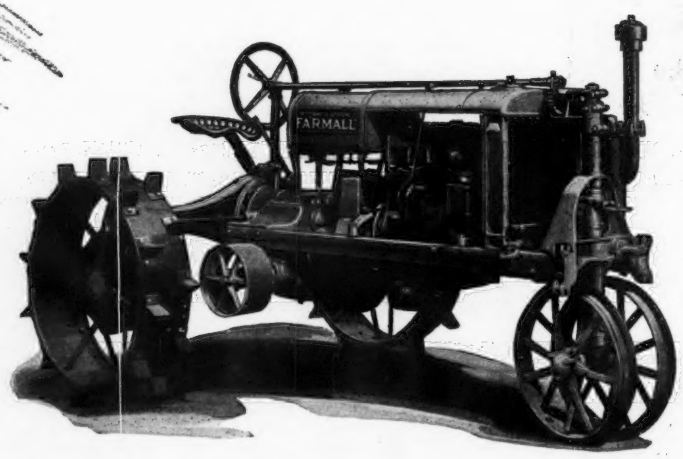
TODAY another invention is creating another far-reaching revolution in farming. This machine is the McCormick-Deering Farmall, the first true *all-purpose* tractor. *In time to come, the invention of the Farmall will stand with the invention of the Reaper in the schoolboy's history book.*

The Reaper began man's emancipation from hand labor in the harvest. The Farmall now frees him from dependence on slow animal power.

The harness, the curry comb, and the pitiless whip are being put in the corner where the cradles and sickles of old have gathered the dust of generations. Even on the row-crop farm, where the horse makes his last stand, there is no longer any sound reason for keeping him. A thousand farmers have already joined the Horseless Farmers of America. In farming, just as in industry throughout the world, the capacity of the machine and the power of the motor are taking up the burden of the human race.

The FARMALL, with 2 or 4-row planter, plants from 25 to 60 acres of corn in an 8-hour day. Cultivates 2 or 4 rows; with 4-row outfit it cleans 35 to 50 acres a day, and in later cultivatings 50 to 60 acres a day. Handles all haying jobs, cutting a 14-ft. swath with 7-ft. Farmall-powered mower and 7-ft. trailer mower attached, also rakes, loaders, etc. Plows two furrows, pulls all seed-bed implements, and operates grain and corn harvesting machines. Available for all drawbar, belt, and power take-off work.

INTERNATIONAL HARVESTER COMPANY
OF AMERICA
(Incorporated)
606 So. Michigan Ave. Chicago, Ill.



McCormick-Deering FARMALL

"Twice the Service from the Machines Equipped with Pressure Lubrication"

"Pressure lubrication well adapted to use on farm machinery."
D. SCOATES
Head, Agricultural Engineering Department
A. and M. College of Texas

"There is nothing as vital to the efficient operation of farm machinery as proper lubrication."
CHAS. E. SEITZ
Head, Agricultural Engineering Department
Virginia Polytechnic Institute

"One way to increase profits on farm crops—lubricate machinery!"
GEO. W. KABLE
Agricultural Engineer, Oregon
Agricultural Experiment Station, Corvallis

"Adequate lubrication will overcome wear of machinery parts."
J. B. DAVIDSON
Professor of Agricultural Engineering
Iowa State College

"Inadequate lubrication is an indirect tax the farming industry is paying."
G. W. McCUEN
Chairman, Dept. of Agricultural Engineering
Ohio State University

"The farmer cannot give too much attention to proper lubrication of farm machinery."
C. I. GUNNESS
Head of Dept. of Agricultural Engineering
Mass. Agricultural College, Amherst

"Users of farm machinery should understand the importance of lubrication."
H. H. MUSSELMAN
Professor, Michigan State College of Agriculture and Applied Science
East Lansing

"The proper lubrication of farm machinery is of prime importance."
F. W. DUFFEE
In charge, Farm Machinery and Farm Power
The University of Wisconsin

"The old time oil hole is more of a salve to the conscience of the machinery builder than it is a means of lubrication."
WM. AITKENHEAD
Chief, Agricultural Engineering, Purdue Univ.
LaFayette, Ind.

"To secure maximum returns for power expended, correct lubrication is absolutely essential."
R. U. BLASINGAME
Head of Dept., The Pennsylvania State College, State College, Pa.

1021

Says M. L. Nichols

Head, Dept. of Agricultural Engineering
Alabama Polytechnic Institute
Auburn, Alabama

"The following is a brief statement of our experience with the pressure system of lubrication: In my opinion the most important element in the economic operation of machinery is correct lubrication. With the recent advancements in the quality of metals used in farm machinery, better systems of lubrication have become more imperative if the full value of the machine is to be obtained.

"Our experience on the farm here is that we get practically twice the service from the machines equipped with pressure systems of lubrication that we get from those with the old oil cup systems."

▼ ▼ ▼

OTHER leading authorities on agricultural engineering endorse high pressure lubrication for farm machinery.

And more than 100 makers of farm equipment have adopted Alemite and Alemite Push-Type High Pressure Lubricating Systems as standard equipment on their products.

The Alemite Systems, together with Alemite Lubricants especially developed for use in them, accomplish three vital results:

1. *Eliminate 80% bearing troubles and consequent breakdowns and repairs.*
2. *Save 50% of time in lubricating.* 3. *Save 33⅓% in cost of lubricants.*

Alemite makes lubricating *easy*—so it is not neglected. *Sure*—so it is done right.

The fittings cost only a few cents. And only a few minutes are required to install them on present farm machinery. They fit into oil holes and grease cup connections—modernizing the lubricating of old-type equipment. Complete information about Alemite for farm use will be sent on request.

Alemite Corporation (Division of Stewart-Warner), 2656 N. Crawford Avenue, Chicago, Ill. Canadian address: The Alemite Products Company of Canada, Ltd., Belleville, Ontario, Canada.

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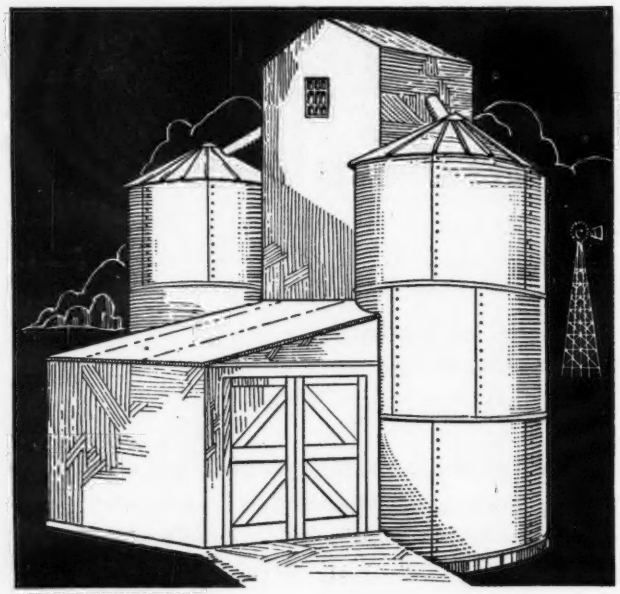
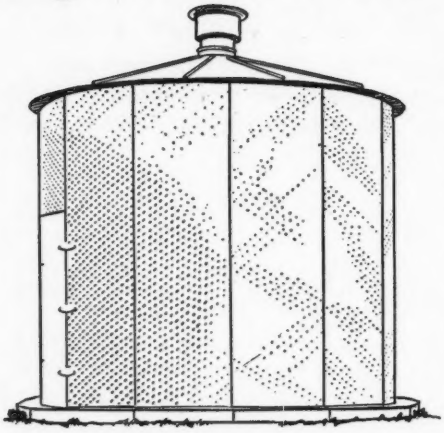
High Pressure Lubrication and Lubricants for Farm Implements



WHETHER FIFTY THOUSAND OR FIVE HUNDRED BUSHELS . . .

Galvanized Cribs and Bins pay for themselves with increased profits



FARMERS with adequate storage facilities never have to worry about the low prices prevailing at harvest time. They can keep their wheat or corn until the after-season high prices — and make bigger profits! Price records for 40 years show that the months of July and August were high months only twice!

Further — the Farm Board is prepared to loan through co-operative associations enough money on corn and wheat now held in approved storage so that, with the credit available from intermediate credit banks and other sources, the farmer can get for immediate use a large part of the price which could be obtained by selling his corn and wheat at harvest prices. He may then hold his crop and take advantage of any market increases.

Low priced, easily obtained, speedily erected, rat-proof, fire-proof, lightning-proof — galvanized grain bins insure better curing, better grading, and allow the farmer to obtain the best price for his crop.

It is in the interest of all of us who would like to see farming put on a better business basis, to bring these facts out into the open. We shall be glad to supply full information on galvanized storage equipment — just write the Trade Research Division, National Association of Flat Rolled Steel Manufacturers, Terminal Building, Cleveland, Ohio.

GALVANIZED SHEETS PROTECT . . . . *the farmers dollars*

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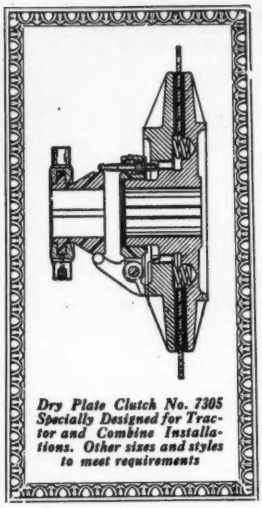

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ORIGINALLY designed twelve years ago as a tractor clutch, the Twin Disc clutch has been developed, improved and adapted to literally hundreds of other machines and uses.

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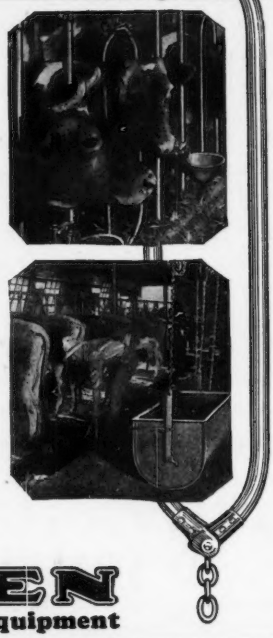
A Quality Reputation of 62 years must be DESERVED



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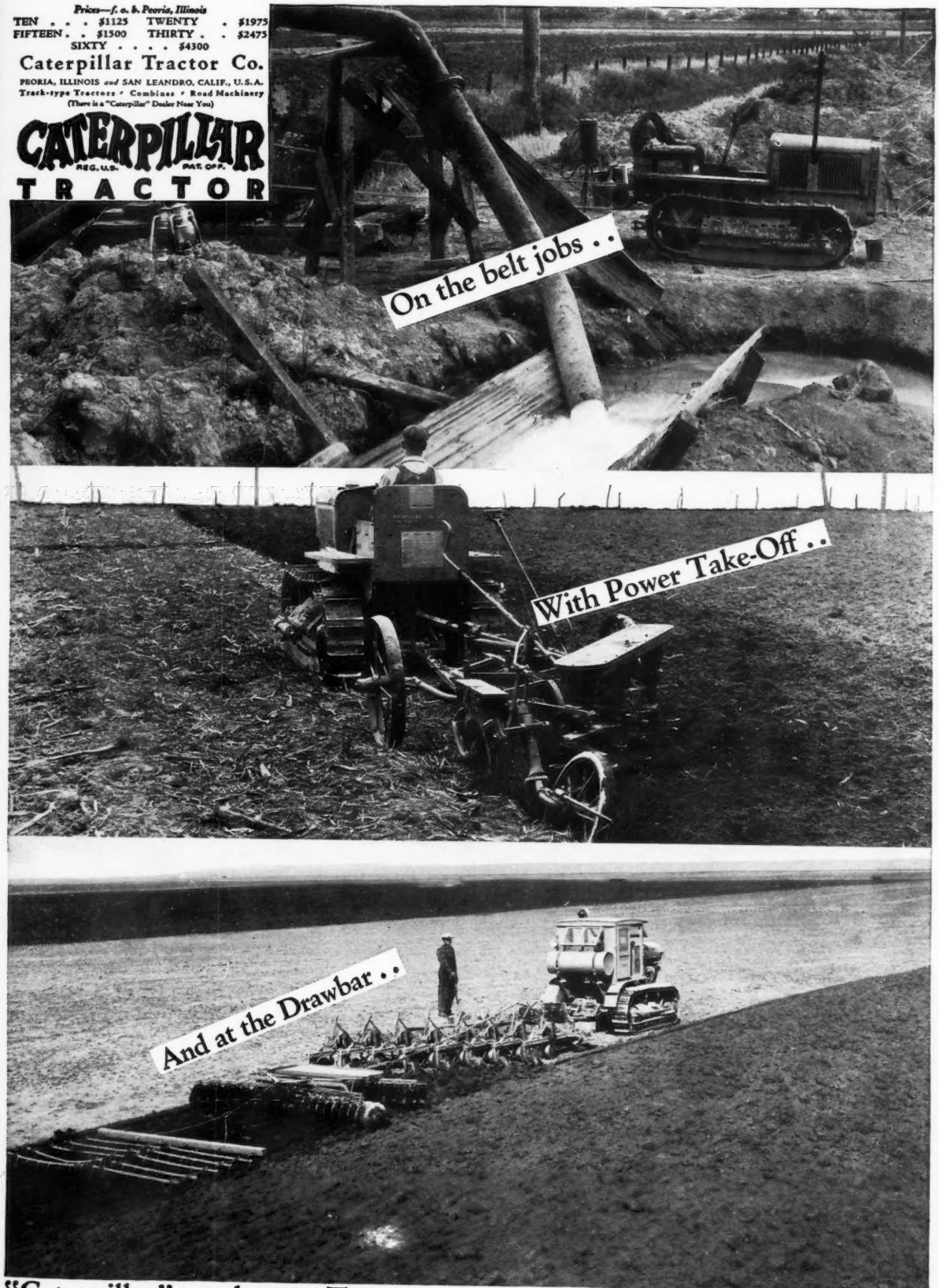

"Caterpillar" track-type Tractors Supply Steady, Dependable Power.

SO radically and so rapidly have previous ideas of bearing performance in tractors, threshers, separators, combines and all other types of farm machinery been revolutionized by Timken Tapered Roller Bearings, that the mechanical reasons which made this performance possible are sometimes lost sight of. Behind the new standards of operating and maintenance costs made possible by Timken Bearings are these fundamental mechanical reasons:

RADIAL LOADS AND THRUST LOADS Because of their tapered construction, Timken Bearings carry without compromise radial loads, thrust loads, or both loads in any combination, making possible more simple, compact, effective, wear-proof, and rigid mountings.

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A PRECISION PRODUCT So accurately and precisely made is the Timken Bearing that it has become the universal standard on machine tool spindles, where a few years ago such accuracy was thought beyond attainment.

FRICTIONLESS The Timken Bearing is practically 100% frictionless: The higher load capacity and greater wear resistance of tapered line contact are thus obtained at an insignificant power loss almost impossible to calculate.

TAKE-UP IN ASSEMBLY The take-up feature in the Timken Bearing is a great advantage in assembly. Manufacturers find this to be of tremendous benefit, as it allows for minor machine irregularities, the locating of gears, etc. Last but not least, since slight wear is inevitable in any machine that revolves—(regardless of any statements to the contrary)—the Timken Bearing is designed for this take-up without affecting the proper operation of the bearing.

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